**The Report Committee for Robert Nathan Anderson**
**Certifies that this is the approved version of the following report:**

# A Methodology to Prioritize Absent Sidewalk Infrastructure for San Antonio, Texas

**APPROVED BY**
**SUPERVISING COMMITTEE:**

**Supervisor:**

Jake Wegmann

Gian-Claudia Sciara

# A Methodology to Prioritize Absent Sidewalk Infrastructure for San Antonio, Texas

**by**

**Robert Nathan Anderson**

**Report**

Presented to the Faculty of the Graduate School of

The University of Texas at Austin

in Partial Fulfillment

of the Requirements

for the Degree of

**Master of Science in Community and Regional Planning**

**The University of Texas at Austin**

**May 2018**

# Dedication

I dedicate this work to those who have been killed by a vehicle while walking, to those who continue to walk, and to those working to make our cities safer and more pedestrian-friendly.

# Acknowledgements

I owe thanks to many individuals for their support and assistance during the completion of this study. I offer my sincere thanks to Jake Wegmann for being my primary reader and for his superlative teaching and support. He helped to facilitate the Institutional Review Board process and helped to acquire the necessary GIS licenses throughout. I thank Gian-Claudia Sciara for agreeing to be a reader as well as for her careful reading and detailed comments. Her comments were exactly the feedback I needed. I am deeply grateful to John Eastman for his mentorship in all things pedestrian-related. His knowledge and skill has contributed greatly to what I know about planning and sidewalks in particular. I also greatly appreciate the provision of specific City of Austin resources that served as a model in this work. I thank the focus group participants for their time, passion, and extensive comments. I offer my thanks to multiple City of San Antonio staff for contributing to my understanding of San Antonio-specific practices for sidewalk prioritization, funding, data limitations, and for helping me to acquire the necessary GIS shapefiles: Shiva Sandrana, Faustino Benavidez, Carlos Villalobos, Tim Mulry, Rebecca Pacini, Greg Reininger, Jillian Harris, Trish Wallace, Garrett Phillips, Saul Teska, Eddie Torres, and Joseph Molina. Thanks to University of Texas at Austin employees Lauretta Wallace, Christine Roquet, Zachary Tycz, and Justin Davis for helping to acquire Business Analyst data. The seemingly simple tasks are sometimes the most complicated! And, I offer thanks to Alex Carroll and Sarah Esserlieu for help in recruiting for my focus group.

On a personal note, I offer my love and thanks to Daniela Radpay for her continual support and her infinite understanding and patience during the completion of this work. I also thank her for her editorial skills.

# Abstract


## A Methodology to Prioritize Absent Sidewalk Infrastructure for San Antonio, Texas

Robert Nathan Anderson, M.S.C.R.P.

The University of Texas at Austin, 2018

Supervisor: Jacob Wegmann

San Antonio lacks a complete sidewalk network, with 2,349 miles remaining to be constructed. Though sidewalks alone are insufficient to create walkability or to achieve important societal goals, they are an important fundamental component. Sidewalks or other pedestrian infrastructure are necessary to achieve important legal, social, and environmental goals. These include compliance with the Americans with Disabilities Act (ADA), combating pedestrian traffic deaths, addressing historical inequality, reducing vehicle miles traveled, attainment of the federal National Ambient Air Quality Standard, and reversing decades-long trends of reduced walking rates and increased obesity. The recently adopted SA Tomorrow Comprehensive Plan also explicitly details the desire to achieve walkability.

The aim of this study is to generate a tool to evaluate the relative importance of absent sidewalks for construction. Importantly, the tool should be easy to maintain and absent sidewalk scores easy to update according to new or improved datasets. A weighted sum model was developed using input from a community focus group. Data was culled

using existing data sets and sorted into four equally weighted indices. The analysis was performed using ArcGIS to arrive at absent sidewalk scores with a range of 0 to 400. The results are displayed in five classes using natural breaks.

The study includes a discussion of funding implications, possible alternatives to sidewalks, and sidewalk maintenance. San Antonio needs to expand its efforts to provide walking infrastructure. In light of significant funding needs for sidewalks, the City should provide continually high funding levels for sidewalk construction through bonds. The City should attempt to find ways to offset large costs to sidewalk construction such as ADA non-compliant driveway construction. And, the City should explore alternatives to sidewalks, such as developing shared streets concepts and using existing street pavement to provide pedestrian space. Lastly, the City needs to develop an asset management program for existing sidewalk infrastructure. It needs to assess the condition of existing sidewalks and develop funding recommendations to ensure a high-quality and ADA-compliant sidewalk infrastructure is maintained.

# Table of Contents

# List of Tables

# List of Figures

# CHAPTER 1: INTRODUCTION

## THE NATIONAL MOBILITY, HEALTH, AND ENVIRONMENTAL PROBLEM

Sidewalks are necessary infrastructure to achieve many community goals, including increasing overall walking rates and walking rates to schools, reducing obesity, pedestrian traffic fatalities, air pollution, and vehicle miles traveled (Schneider 2013). The U.S. population is more sedentary than in the past, and obesity rates for both children and adults are increasing (Ogden et al. 2014), as are the associated chronic health diseases (U.S. Department of Health & Human Services 2015). The problem is becoming more pronounced, though - walking constitutes a small fraction of adult commuting (McKenzie 2014) and walking rates to school have declined considerably over the last five decades (Martin and Carlson 2005; Appleyard 2003; Boarnet et al. 2005). There is elevated attention to the effects of climate change, and there is increasing government attention to achieving walkable communities as a response to community health, traffic safety, and traffic congestion (Schneider 2013). Additionally, the last decade has seen an increase in the number of pedestrian deaths and an increase in the pedestrian share of all traffic fatalities (Domonoske 2018).

Research has established that there are a number of complex built environment factors which influence walking rates; these include distance to an intersection, density of housing and street intersections, and land use diversity, among others (Ewing and Cervero 2010; Saelens and Handy 2008; Cervero and Kockelman 1997). Other research exists that shows parents' perceptions of traffic safety influence whether they allow their children to

participate in Safe Routes to School (Ewing et al. 2004; Nevelsteen et al. 2012; Rivara et. al 1989; Ziviani et al. 2004). Density, diversity, and design of land uses (Cervero and Kockelman 1997), and safety of the roadway are a few of the factors that influence walking rates. The research regarding factors influencing walking rates is not as extensive as it needs to be to fully inform infrastructure decision-making. However, the factors that are known to influence walking rates can and should factor into the development of a data-driven methodology for allocating capital dollars for new sidewalk construction.

As indicated above, research supports the prioritization of missing sidewalk construction where those missing sidewalks are in close proximity to multiple "pedestrian attractors" and where sidewalk completion can address known safety issues. Additionally, it is believed that historical inequities and community preferences should be considered. Pedestrian attractors, safety, historical inequities, and community preferences deserve priority for absent sidewalk construction for several reasons: 1) The street is already experiencing a higher relative volume of pedestrian use; 2) There is a higher potential for pedestrian usage relative to other streets with missing sidewalks; 3) Safety benefits will result; and 4) It is likely that a sidewalk prioritization method will receive greater community and political support if the public was allowed to contribute to its development.

## THE NEED FOR SIDEWALKS

Despite the fact that increasing the rate of walking can improve multiple mobility, health, and environmental problems, many communities are failing to provide the most basic infrastructure to support walking: sidewalks. This is partly a reflection of policies

and budgets that allocate too few resources to pedestrian infrastructure. But, even well-intentioned cities are now significantly constrained financially in their ability to complete sidewalk networks after decades of prioritizing automobile infrastructure and neglecting to require sidewalk construction concomitant to development. The costs for completing a sidewalk network across an entire city in most cases precludes short-term solutions without the provision of increased funding and/or consideration of alternatives to traditional sidewalks. Therefore, it is important to consider how to prioritize sidewalk construction.

More attention needs to be given to the topic of how municipalities can and should direct limited/insufficient funds for the construction of missing sidewalks. In particular, the decades- or centuries-long timeline for many cities to complete their sidewalk networks requires that cities triage sidewalk construction to maximize the potential benefits of sidewalk infrastructure while satisfying the accessibility requirements of the Americans with Disabilities Act.

## RESEARCH QUESTION

It is the goal of this study to answer the question: What is a data-driven methodology to prioritize the construction of absent sidewalks which can be applied across the City of San Antonio, and which reflects the values of the community through the identification of specific criteria and the weighting of scores? This question is answered to provide a more sophisticated method for city staff to use in determining which sidewalks to complete with limited funds.

## OVERVIEW OF THE STUDY

This study began with a review of literature regarding governmental decision-making models. Various decision-making models were reviewed for their potential application to transportation planning and that would be appropriate for use at the level of local government. Because municipalities are often constrained in capacity, resources, and time (Dodgson 2009), a model that would be simple to build, use, and maintain were desirable characteristics. Ultimately, a Weighted Sum Model was identified as the model with the most positive features, the simplest to build and use, and the most common among peer cities prioritizing absent sidewalk infrastructure.

A comparison of peer cities was conducted to identify common criteria included in sidewalk prioritization. The universe of potential criteria was then screened through a focus group. The focus group consisted of eight San Antonio residents and agency staff with expertise in transportation planning, disability advocacy, active transportation, and social justice. The assumption of the author was that the focus group would possess the requisite knowledge to develop a useful set of criteria for prioritizing San Antonio's absent sidewalks that are reflective of San Antonio's culture and values.

The results of the focus group session and the peer cities research was the basis for developing the Absent Sidewalk Prioritization Model. The model is comprised of four indices (Policy; Demographic; Pedestrian Attractors; and Pedestrian Safety / Health) and 26 separate criteria. The necessary data was collected from multiple government agencies to support the analysis and display of results in ArcGIS.

The analysis was performed in ArcGIS and scores assigned to every one of over 29,000 absent sidewalk segments according to their presence within a census tract (for the Demographic index components), or within a one-quarter mile Euclidean buffer to selected criteria. Scores were either binary or tiered according to multiple classes with scoring thresholds determined using a natural breaks method. The focus group determined that each index was to be valued equally at 100 possible points. Each criterion internal to the indices was also weighted according to the focus group's preferences.

Finally, recommendations are offered to assist San Antonio in the development of future iterations of the Absent Sidewalk Prioritization Model, additional funding strategies, and alternatives to conventional sidewalks.

## THE STATE OF SIDEWALK INFRASTRUCTURE IN SAN ANTONIO

Currently, San Antonio prioritizes sidewalk construction using a GIS-based approach that aims to complete sidewalk gaps, prioritizing a missing segment's proximity to schools and hospitals (MWM Design Group and City of Austin 2015). The missing sidewalks were identified, and a GIS shapefile was created from digitizing aerial images (MWM Design Group and City of Austin 2015). The Sidewalk shapefile is maintained manually by Transportation and Capital Improvement (TCI) Department staff. According to TCI staff, Vision Zero safety goals are also infused into the prioritization process (Pacini 2018), but it is unclear to what degree this has been incorporated into the GIS-based prioritization that considers schools and hospitals. A primary goal of this study is to increase the robustness of the missing sidewalk prioritizing used by San Antonio.

Sidewalk maintenance is prioritized according to citizen request as it relates to compliance with the Americans with Disabilities Act (MWM Design Group and City of Austin 2015). At present, no comprehensive condition assessment for the city's sidewalk system exists. As such, it is impossible to know the extent to which sidewalks are broken, possess ADA non-compliant slopes, possess vegetative obstructions, or are missing ADA-compliant curb ramps. Updating and maintaining the existing sidewalk system is a critical asset management task. City staff are expecting to hire a consultant to execute a condition assessment of existing sidewalks and anticipate that this will be completed in Summer 2018 (Villalobos 2018).

Numerous San Antonio policies, plans, and programs relate to sidewalk infrastructure. The SA Tomorrow Comprehensive Plan establishes a vision for a walkable community, particularly for identified regional centers and transit corridors (MIG and City of San Antonio 2016). A rolling five-year Infrastructure Management Program exists to address infrastructure maintenance issues, and in 2009 the first Americans with Disabilities Act (ADA) Sidewalk Transition Plan was developed (City of San Antonio Infrastructure Management Program 2018). The Vision Zero Initiative aims to eliminate traffic fatalities and serious injuries (City of San Antonio Vision Zero Initiative 2018). And, a voluntary sidewalk cost-sharing program exists for property owners to share in the cost of sidewalk installation or replacement (City of San Antonio Sidewalk Cost Sharing Program 2018). However, the city lacks a Sidewalk Master Plan and a methodology to guide the completion of its significant absent sidewalk network.

Pedestrian safety is another major issue facing San Antonio that directly relates to the need for more sidewalks. San Antonio has averaged 149 total traffic deaths per year, including 46 pedestrian deaths per year, since 2010 (Selcraig 2018b). In fact, San Antonio is among the most dangerous big cities in the country for pedestrians (Merck 2018). Sidewalks are necessary to provide safe mobility for San Antonio's residents.

San Antonio lacks a complete sidewalk network and the necessary capital dollars to build this vital and basic infrastructure in a timely manner without substantial increases in funding. San Antonio is not unique in this respect; many cities around the United States that grew substantially after the introduction of the automobile did not require construction of sidewalks concurrent with development. This has resulted in significant infrastructure deficits and decades- or centuries-long horizons to catch up.

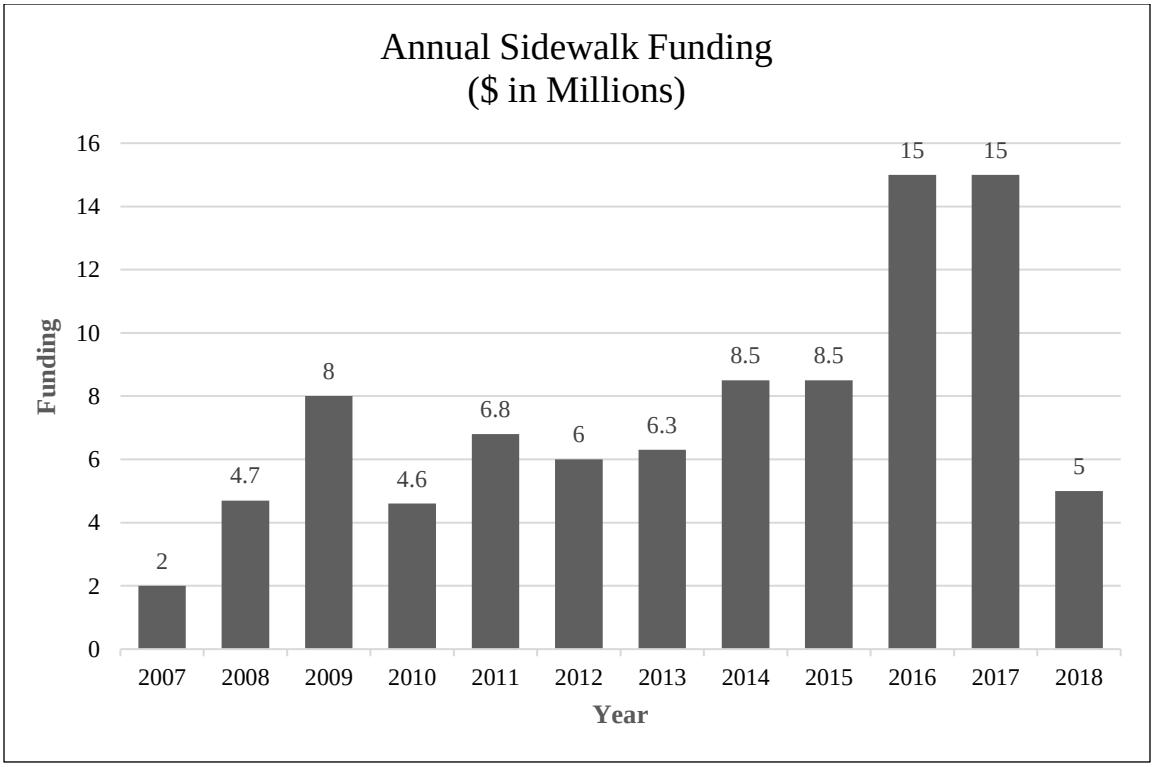
San Antonio has 4,769 linear miles of existing sidewalks and 2,484 linear miles of missing sidewalks (MWM Design Group and City of Austin 2015). Considering an average construction cost of $486,270 per linear mile,[1] San Antonio faces a $1.21 billion capital need. With an average construction rate of 11.2 miles per year (MWM Design Group and City of Austin 2015), San Antonio will not complete its sidewalk network for another 222 years. Recent increases in sidewalk funding can potentially help to expedite the completion of the sidewalk network. For Fiscal Year 2016, the City allocated $15 million, almost double the funding provided for both 2014 and 2015 (Marks 2018). But, even assuming

[1] According to Appendix D page 5 in Austin's Peer Cities Report, the cost of new sidewalk construction for a linear mile of sidewalk in San Antonio is $486,270. This figure was calculated by dividing the $8.5 Million allocated by the 17.48 miles of sidewalk planned for construction.

the city were to maintain these funding levels, it would take another 81 years before achieving a completed sidewalk network.

Figure 1 displays annual sidewalk expenditures, which includes both new sidewalk construction and maintenance dollars.[2]

*Figure 1: Annual Sidewalk Funding in San Antonio*




Source: Dimmick, Iris. "Treviño Demands 'Concrete Solutions' for San Antonio's $760M Sidewalk Gap."

There are $78 million available for new sidewalk construction as a result of the voter-approved 2017-2022 bond, with an additional $5 million dedicated from the city's

[2] The City of San Antonio doesn't track new construction and maintenance dollars separately complicating efforts to understand funding levels for new sidewalk construction (MWM Design Group and City of Austin 2015, 15).

fiscal 2018 budget (Dimmick 2018). If the city continues to provide $5 million annually in its budget over the 6-year bond cycle, together these sources would supply $108 million total, averaging $18 million per year. Even at these historic levels of funding, if maintained, it will take 67 years to complete the sidewalk network.

Other funding sources exist including Community Development Block Grant funds and an Advanced Transportation District with a voter-approved quarter-cent sales tax, 25% of which goes to sidewalk maintenance and construction (MWM Design Group and City of Austin 2015).

The significant number of miles of absent sidewalks requiring construction is daunting. However, the costs associated with new sidewalk construction do not account for the financial burden of maintaining existing sidewalks, nor costs associated with bringing existing sidewalks into compliance with the Americans with Disabilities Act, neither of which are being adequately funded. The Americans with Disabilities Act (ADA) Title II, Subpart A requires public entities to establish and maintain a Transition Plan to achieve full accessibility of existing public infrastructure, including existing sidewalks within the public right-of-way (United States 2016).

Some cities accept responsibility for the maintenance of their sidewalk infrastructure in the same way they own and maintain all other infrastructure (MWM Design Group and City of Austin 2015).[3] However, San Antonio does not accept responsibility for sidewalk maintenance. In this way, by failing to manage a critical asset

[3] Cities such as Austin, Houston, Nashville, Charlotte, and Seattle accept responsibility for the maintenance of their sidewalk infrastructure.

San Antonio is setting itself up for future sidewalk funding deficits. This is especially true as San Antonio does not enforce the requirement that property owners maintain the sidewalk along their property (Selcraig 2018a).

Courts have established legal precedent forcing municipalities to come into compliance with the requirements of the Americans with Disabilities Act (ADA). In Barden v. City of Sacramento, the United States Court of Appeals concluded that the ADA covers "anything a public entity does" and any "normal function of a government entity," including sidewalks (Shoup 2009, 22). The outcome of the case requires the City of Sacramento to spend 20% of its annual Transportation Fund towards right-of-way accessibility for up to 30 years. A similar lawsuit against the City of Los Angeles and ADA non-compliant sidewalks resulted in a $1.4 billion agreement to be paid over three decades (Goodyear). Other cities, too, have faced lawsuits forcing additional funds and expedited sidewalk completion or repairs: Jackson, Mississippi; New York City; Long Beach, California; Cedar Rapids, Iowa; and, Seattle (Goodyear 2018; Clark 2018; Cohen 2018). Cities are legally liable for the infrastructure they own; that is a key reason why cities such as Austin accept the financial responsibility for maintaining sidewalks. San Antonio is vulnerable to a lawsuit due to the insufficient funds provided for completing the sidewalk network, for maintaining existing sidewalks, and upgrading existing facilities to come into compliance with the Americans with Disabilities Act.

San Antonio is providing insufficient funding to meet its sidewalk maintenance obligation, allocating only $2.748 million in 2015. (MWM Design Group and City of

Austin 2015).[4] Assuming $18 per square foot for sidewalk maintenance costs, a conservative estimate suggests San Antonio should be allocating approximately $24.2 million a year simply to maintain its existing sidewalks.[5] **If San Antonio wishes to achieve a complete sidewalk network in 25 years, it will require $48.3 million per year for new sidewalk construction. If it wishes to maintain existing sidewalks, it needs to be providing $24.2 million annually now, and to be increasing that amount to $36 million per year as more sidewalks get built. San Antonio should be spending at least $72.5 million per year for new sidewalk construction and maintenance together. The historic high funding level of $18 million for fiscal year 2017-2018 falls well short of this target.**

[4] The City of San Antonio allocated $6.758 Million within its bond program for sidewalk improvements prior to the 2016 Mobility Bond. But, the City doesn't track new construction and maintenance separately.
[5] The $18 per square foot for sidewalk maintenance was derived from *City of Austin Sidewalk Master Plan / ADA Transition Plan Peer Cities Report*, page 33. The estimate for sidewalk maintenance funds conservatively assumes a sidewalk width of just 4' citywide. Because the City of San Antonio doesn't have data for existing sidewalk widths, this number could be much higher. Four foot sidewalk widths are minimum construction standards. But, there are sidewalks that exceed those dimensions which would increase the funding needs for maintenance. The required maintenance budget assumes a 75-year lifespan for a sidewalk segment.

# CHAPTER 2: DECISION-MAKING MODELS AND PRACTICES OF PEER CITIES

Chapter 1 established the extent of San Antonio's sidewalk problem. San Antonio is missing 2,484 linear miles of sidewalks (MWM Design Group and City of Austin 2015) and faces a $1.21 billion capital need. Due to the fact that San Antonio is averaging only 11.2 miles of new sidewalks constructed annually (MWM Design Group and City of Austin 2015), it will not complete its sidewalk network for another 222 years. It is this authors contention that San Antonio simply must allocate more money annually to more quickly complete the sidewalk network, and that cheaper alternatives should be pursued to relieve some of the financial burden.

However, even with a greater level of available sidewalk construction funds and a reduced capital burden possibly achieved through alternatives to conventional sidewalks, San Antonio will likely still require many decades to complete its sidewalk network. In order to achieve the walkability ideals expressed in the SA Tomorrow Comprehensive Plan (MIG and City of San Antonio 2016), and to achieve other environmental, mobility, and health benefits, San Antonio must be strategic. It must focus on building first the sidewalk infrastructure that is most needed and that is most likely to increase walking rates. Prioritizing the extensive amount of absent sidewalk infrastructure requires a formal decision-making process.

The problem of prioritizing sidewalks for San Antonio is symptomatic of broader shortcomings of contemporary metropolitan transportation planning. According to Liu, "Effective prioritization of infrastructure projects are hindered by a series of constraints

including but not limited to institutionalized inefficiency, inadequate data obstructing decision-making, insufficient coordination among various stakeholders, lack of public consultation, lack of technical capacity for project programming, and lack of consideration of possible alternatives in the infrastructure planning" (Liu 2015, 193). Prioritization of infrastructure, if done properly, affords legitimacy to decisions, particularly in the context of active democracies where public assent and approval matter (Marcelo et al. 2016).

Infrastructure beyond sidewalks can potentially influence walking rates, too. For example, the presence of trees can provide shade against summer heat, public benches can provide places to rest, and street lighting can improve safety. If the provision of this infrastructure would be a significant investment to a city, it would similarly be wise to determine a method for prioritizing the most urgently needed elements. However, for this study, the focus is solely on developing a decision-making model for absent sidewalk construction. The next section discusses several different types of decision-making models that could be used.

## A Review of Infrastructure Prioritization Methods

Numerous frameworks exist for decision-making that have been applied to infrastructure prioritization from national to municipal levels of government. The review of various approaches to government decision-making was performed in order to understand the universe of decision-making models available for use, as well as to seek out a model appropriate for transportation infrastructure for use by a municipality. This section provides a general description of seven frequently-used decision-making models,

including: 1) Cost Benefit Analysis (CBA); and 2) Social Cost Benefit Analysis (SCBA). Various Multi-Criteria Decision-Making Analysis (MCDA) models are also reviewed, including: 3) Technique for Order Preference by Similarity to an Ideal Solution (TOPSIS); 4) Elimination Et Choix Traduisant la REalite (ELECTRE); 5) Preference Ranking Organization METHods for Enrichment Evaluation (PROMETHEE); 6) Analytic Hierarchy Process (AHP); and 7) Weighted Sum Models (WSM). The models are reviewed for their general strengths and weaknesses, their appropriateness for prioritizing sidewalk infrastructure, and their appropriateness for use by a municipality with limited capacity, resources, and time. More attention is given to analyzing the merits of MCDA models as they seemed to possess more potential for use in this study. Ultimately, a Weighted Sum Model was chosen for this study and is discussed last.

*Cost Benefit Analysis (CBA)*

According to the CBA model, the goal of infrastructure spending should be to maximize the value of the investment or expenditure. In this approach, the present value of an investment is determined by taking all future discounted returns created by the investment minus the initial investment (Marcelo et al. 2016). A key strength to the CBA method is it allows decision-makers to compare and select projects intuitively according to a single metric – the monetized value captured by the project as reflected by a positive present value.

A positive Net Present Value – a good investment – results if an investment's future avoidance costs are higher than the initial investment (White and Villarreal 2013). Future

avoidance costs can include such things as unscheduled maintenance needs, the costs of deferred maintenance, the costs of failing to maintain an adequate level of service, and accurate evaluation of sidewalk life cycle (White and Villarreal 2013).

There are several key limitations to using CBA. First, employing CBA requires extensive knowledge of full project costs and benefits. CBA also requires generating future projections for things such as avoidance costs, and future projections can contain errors. However, decisionmakers often must act with incomplete and imperfect information, and future projections can contain errors.

Second, there is disagreement about how to select an appropriate discount rate to apply for transportation infrastructure projects' CBA. The discount rate is the rate of return in discounted cash flow analysis used to determine the present value of future cash flows. Essentially, it determines what your future money is worth today and the question is at what rate is the money expected to grow. But, the present value of future money is done in reverse, and the problem is one of discounting rather than growing. Even slight variations in the discount rate can have substantial effects on the benefit-cost ratio of projects being evaluated (Thomopoulos et al. 2009).

Third, CBA applies a strictly financial lens to project prioritization. At some point, all project impacts must be expressed in monetary terms. According to Johansson-Stenman, in many cases it is not easy – or possible – to express a project's impacts in financial terms (1998). This is true for such things as health impacts and social equity which the CBA model has limited ability to incorporate.

Fourth, CBAs are not adequately able to deal with issues of equity or social justice. And, while CBAs attempt to identify the best project for society writ large, they are not suited to deal with distributional effects, or specific benefits or drawbacks to specific groups. To account for these social effects, CBAs typically must be supplemented with social assessments or multi-criteria decision analyses (Marcelo at al. 2016).

There is also a broader question about the appropriateness of the CBA model for municipalities. At a national level, infrastructure prioritization for large projects can evaluate the economic effects that would result from the project alternatives, effectively capturing a cost benefit (Marcelo et al. 2016). At a municipal level, too, there may be infrastructure projects large enough to generate economic benefits. But, an individual sidewalk segment is unlikely to generate those effects. While some city departments or utilities may operate as enterprises, thus generating revenue, it is not universal, and more of the exception than the rule. To use an infrastructure prioritization model that, at its core, evaluates financial return on investment fundamentally ignores how municipalities operate. Many municipal functions such as garbage collection and sidewalk construction are not expected to generate revenue and the social value of these functions is not easily determined.

*Social Cost Benefit Analysis (SCBA)*

The Social Cost Benefit Analysis (SCBA) attempts to redress the largest limitation of the CBA model. Namely, it attempts to consider social and other indirect project costs, such as the improved safety or health benefits of a more complete sidewalk network, or

greater accessibility for those who are disabled. A benefit of this approach is it can attempt to maximize the net present value for all individuals of society versus only for those individuals directly impacted by the project (Saitua 2007).

However, where an SCBA may potentially be more fruitful by accounting for costs and benefits not usually factored into CBA, key limitations remain, and additional challenges are created. Although SCBA attempts to consider broader societal costs and benefits not typically accounted for in CBA (Marcelo et al. 2016), those benefits must still be expressed in monetary terms. Because social costs and benefits are difficult to express in monetary terms, this remains a major limitation. A further criticism is where dollar amounts are ascribed to social and environmental impacts, they are frequently underestimated (Marcelo et al. 2016).

Both CBA and SCBA requires quantification of all costs and benefits of a project. In order to accomplish this, extensive information is required. Due to the additional analysis required of an SCBA through the incorporation of social factors, an SCBA can pose additional burdens on government decision-makers already constrained in their capacity, resources, and time (Dodgson 2009). SCBA's extensive information requirements relating to project costs and benefits, and local governments' limited ability to meet them broadly suggests SCBAs are impractical as a prioritization tool.

*Multi-Criteria Decision Analysis (MCDA)*

Numerous models exist to prioritize infrastructure that fall under the broad categorization of Multi-Criteria Decision Analysis (MCDA). MCDA is a decision-making

tool used to evaluate investment decisions that involve multiple aspects requiring reconciliation and/or multiple stakeholders with diverse views. MCDA works by making a set of assumptions about the underlying problem that the model is based on. The model then delivers a set of ranked options. All important aspects of the problem to be considered must be included in the underlying assumptions built into the model (Dodgson et al. 2009)

Several characteristics of MCDA lend themselves particularly well to transportation issues and help to explain their growing use. Marcelo et al. note that in the last few years the U.K., Australia, and many U.S. states have provided guidance on the use of MCDA (2016). Some countries have even proposed specific criteria for when to use an MCDA, or even a simpler prioritization model depending on the scale of the proposed investment (Marcelo et al. 2016). The multiple advantages of MCDA are the reason it was used for this study.

MCDA possesses several inherent strengths. First, MCDAs are intuitive and easy to use. They are potentially easier to use than other decision-making models as they don't require complicated software. And, they are intuitive in the way the multiple and sometimes conflicting criteria are displayed and evaluated against each other. This is an advantage to governments with limited capacity for complex analytic tools.

Second, MCDA is capable of incorporating non-monetary and qualitative factors into its analysis which is essential to deal with social issues that must be accounted for in decision-making (Marcelo et al. 2016). The ability to incorporate non-monetary and qualitative factors into the analysis lends itself especially well to government decision-making built around a public input process.

Third, MCDA provides a useful alternative to optimization models which require complete information to maximize societal benefits. MCDA is particularly useful for decision-making if information is incomplete or multiple policy priorities are at issue, such as traffic safety or fulfilling the land use objectives of a comprehensive plan. It offers a way to evaluate alternatives through compromise of multiple priorities (Beinat & Nijkamp 1998). According to Tsamboulas, the different objectives and complex issues surrounding transportation projects have made MCDA a particularly useful model for project evaluation (2007). Complexities include various criteria, different geographic or government scales, types of data, and uncertainties surrounding project evolution.

MCDAs are ideally suited to government decision-makers with capacity, resource, and time limitations that would otherwise have to expend significant effort to cull and improve data sets before project evaluation could commence. For governments needing to evaluate significant numbers of small- and medium-sized infrastructure alternatives, MCDA offers relief from the onerous information requirements of CBA and SCBA.

Fourth, MCDAs have the benefit of flexibility as a method to evaluate projects since they can be recalibrated to accommodate new or improved data related to the project as it becomes available (Marcelo et al. 2016). Because San Antonio currently lacks quality data sets but needs to proceed with sidewalk prioritization, MCDA is a useful tool. The flexibility of MCDA is an ideal way to provide interim analysis while providing an opportunity to identify the datasets in need of refinement.

Fifth, MCDA is ideally suited to open government practices. The intuitive and easy-to-understand nature of MCDAs fosters community involvement. And, MCDA can involve

more than one decision-maker such as elected officials, agency representatives, or experts. Lastly, MCDAs are conducive to a public engagement process which can increase knowledge and generate alternatives for project evaluation (De Montis et al. 2004). Importantly, public participation through an engagement process can help to identify the very factors to be used in project evaluation. Such a practice not only fosters increased public trust but creates the very legitimacy of a planning process that may be required for public approval and/or support of the project funding required for implementation.

The literature on MCDA identifies several weaknesses of the tool, including the absence of more traditional economic analyses, potential bias in the selection of criteria (Marcelo et al. 2016), and possibility of compensation effects with one good score compensating for a bad score in another criterion (Tscheikner-Gratl 2017). These identified weaknesses are present in MCDA, but no prioritization tool is perfect. To address each in turn, MCDA can be supplemented with a CBA or SCBA to highlight the broader societal effect possible with project alternatives. But even used independently, MCDA offers substantial benefits relating to open and deliberative governance, accountability, and efficiency that more than compensate for the more robust economic evaluation provided through other methods (Marcelo et al. 2016).

MCDA is vulnerable to bias or manipulation in the selection and/or weighting of evaluation criteria. However, this is not unique to MCDA. Evaluation tools that rely exclusively on expert opinion, that are complicated and difficult to understand by the public, and that are less transparent, are more subject to manipulation. The features of

MCDA can potentially reduce the possibility of manipulation or selection bias through transparency and by implementing and adhering to a formal process (Marcelo et al. 2016).

Last, unlike some decision-making models that set scoring thresholds to evaluate projects and eliminate alternatives, MCDA scoring is compensatory in nature allowing for the bad scores on some criteria to be made up for by other criteria. And, while the literature identifies compensatory effects as a weakness, it is not always a weakness; it can, in fact, be a positive feature by identifying the best projects overall. The order of steps in MCDA is important. The selection and weighting of criteria must be done prior to analysis to ensure transparency and legitimacy to the process. The project scores resulting from the analysis are the product of that process. Adjustment of the criteria and weights that feed into the final scores after initial analysis has been performed is a more egregious form of manipulation.

Multi-criteria analyses are, by definition, concerned with multiple factors. The magnitude of difference in the criteria's scores should be taken into consideration. A project that performs only moderately well on all criteria is perhaps less important than a project that scores very well on a few, if not all, criteria. The weakness of compensation effects is moot if the selection and weighting of the criteria reflect the values of the community and decision makers.

Two important issues for the use of MCDAs are the selection of criteria by which projects will be evaluated and the weighting of the criteria. The selection of criteria underscores the specific community values, policy priorities, and the expected costs and benefits of the project (Marcelo et al. 2016). Project criteria and scoring weights can be

accomplished through multiple means; they can involve expert opinion, policy priorities, or public preferences. The weighting of criteria is also important. The simplest method is to weigh all criteria equally. However, criteria may be weighted equally or assigned weights relative to the importance of the criteria (Marcelo et al. 2016).

The above discussion deals with MCDA tools, broadly. Several different varieties of MCDA exist. Tscheikner-Gratl et al. identify three types of MCDA tools: 1) Goal, Aspiration, and Reference Level Models; 2) Outranking Models; and 3) Value Measurement Models (2017). The following briefly discusses salient features of the various MCDA sub-types.

### Goal, Aspiration, and Reference Level Models

*TOPSIS (Technique for Order Preference by Similarity to an Ideal Solution)*

The TOPSIS method is one example of a Goal, Aspiration, and Reference Level Model and evaluates how good alternatives are at achieving stated goals. It is a method of evaluating alternatives by calculating the geometric distance of scores between each project alternative to the ideal scenario. This method has been used in infrastructure projects but requires complicated analysis and vector normalization of scores due to the incongruous nature of the different criteria (Tscheikner-Gratl et al. 2017). It was determined that TOPSIS was inappropriate for this study due to the disadvantages of the method, particularly the complexity of performing the analysis.

Outranking Models

Outranking models work by comparing the various alternatives pairwise for each criterion and finding one preferred alternative over the others.

*ELECTRE (ELimination Et Choix Traduisant la REalite)*

ELECTRE (ELimination Et Choix Traduisant la REalite) is a family of seven outranking models that takes into account three types of situations: Preference, indifference, and incomparability (Tscheikner-Gratl et al. 2017). Tscheikner-Gratl et al. note that they are used primarily in Europe for rehabilitation of sewers and for urban stormwater management (2017). There are disadvantages, including that they aim to select a small set of preferred alternatives, but not to rank them, the complexity of application, and the time it takes to use (Tscheikner-Gratl et al. 2017). The disadvantages render ELECTRE unsuitable for this study and for the City of San Antonio to adopt as a method to evaluate missing sidewalk infrastructure.

*PROMETHEE (Preference Ranking Organization METHods for Enrichment Evaluations)*

PROMETHEE is another family of outranking models. It aims to find the alternative that best suits the goal of the decision-maker by providing a rational framework for structuring the decision-making process. The ranking of alternatives is determined by calculating the positive and negative outranking flow for each alternative (Tscheikner-Gratl et al. 2017). Essentially, PROMETHEE uses the preferential function to show the difference in scoring between pairs of alternatives on each criterion. Although it has been used in transportation decision-making (Behzadian, Majid, et al. 2010) and is a relatively

simple ranking method and easy to execute as compared to other models (Brans et al. 1986), it possesses disadvantages. While simple compared to some outranking models, it requires specific and difficult-to-use software. It also becomes more difficult when more criteria are included in the decision-making process (Tscheikner-Gratl et al. 2017). Further, it is also time-intensive (Tscheikner-Gratl et al. 2017). For these reasons, it was determined to be unsuitable for this analysis.

### Value Measurement Models

Value measurement models determine a numerical score for each alternative using weights for each criterion that reflects the importance of that criterion in the decision-making process.

#### *Analytic Hierarchy Process (AHP)*

Analytic Hierarchy Process (AHP) relies on expert opinion rather than quantitative or qualitative data to assign values to criteria and weights (Marcelo et al. 2016). This is achieved through decision-maker responses to a series of pairwise comparisons of the alternatives (Thomopoulus et al. 2009). This method lacks the transparency and community engagement components essential to the successful negotiation of infrastructure prioritization.

#### *Weighted Sum Models (WSM)*

Weighted Sum Models (WSM) help decision-makers identify the optimal alternative by selecting the alternative closest to the best-case scenario. It works by summing all the criteria scores with their assigned weights. WSM models are flexible in

how they can be constructed and can deal with almost any decision-making problem (Tsamboulas 2007). The composition of the criteria must be considered. Scoring is simple if all of the criteria are all of the same dimension (e.g., quantitative or qualitative). Multi-dimensionality, however, requires normalization (Tscheikner-Gratl et al. 2017).

The Weighted Sum Model provides the ideal combination of strengths to satisfactorily address San Antonio's limitations of time, resources, technical capacity, and data quality. It is also capable of incorporating policy priorities and fulfills planning's emphasis on public engagement. WSMs are advantageous because they are intuitive, easy to understand, and work with governmental goals of transparency, and are especially conducive to alignment with a public engagement process. Additional advantages are the flexibility in how they can be constructed and the ability to deal with almost any decision-making problem (Tsamboulas 2007). The simplicity of the application is especially useful for governments constrained in capacity, resources, and time (Dodgson 2009). The simplicity of the method ensures governments can easily construct and maintain decision-making rubrics with large quantities of data. Furthermore, WSMs perform as well as more sophisticated models (Kabir et al. 2014) and can do so without the higher quality data required by more complicated models (Tscheikner-Gratl et al. 2017).

### HOW PEER CITIES PRIORITIZE SIDEWALKS

A review of numerous peer cities reveals sidewalk prioritization schemes based upon Weighted Sum Models. The review also identified the criteria used to evaluate absent sidewalk infrastructure commonly included within the prioritization models, as seen in

Table 1. The criteria within each index is ranked according to how many cities use the criteria within their prioritization method.

The criteria used by other cities formed a universe of possible criteria for incorporation into this study. It was also the set of criteria used as a check within the focus group. If the focus group failed to independently identify common elements listed below, the facilitator asked the participants directly whether it should be included for San Antonio's prioritization system.

*Table 1: Peer Cities' Sidewalk Prioritization Criteria*[6]

| Index | Criteria | San Antonio | Nashville | Louisville | Memphis | Raleigh | Austin | Denver | Seattle | Fort Collins | Alexandria |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Connectivity to Destinations | Schools | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | Places of Public Accommodation (library, grocery stores, police, station, health center, post office, etc.) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ |
| | Park or Greenway | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| | College / University | ✓ | ✓ | ✓ | | ✓ | | ✓ | ✓ | | |
| | Community Center / Recreation Center | ✓ | ✓ | | ✓ | ✓ | ✓ | | | | ✓ |
| | Retail Shopping | ✓ | ✓ | ✓ | | | ✓ | | ✓ | ✓ | |
| | Hospital | ✓ | ✓ | | | | ✓ | ✓ | ✓ | | |

[6] The information contained in this table was adapted from City of Nashville's *WalkNBike Peer City and Aspirational City Review*. Indianapolis and Minneapolis were removed from the table because they don't have a prioritization method. San Antonio and Alexandria were added to the table; Alexandria to add another city with a prioritization method, and San Antonio to show how the developed model compares to other cities. All information was checked for accuracy against the original city plans and the table modified accordingly to show the criteria used and to reflect the ranking of criteria most commonly used.

*Table 1: Peer Cities' Sidewalk Prioritization Criteria (continued)*

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Connectivity to Destinations | Senior Housing or Assisted Living Facility | ✓ | ✓ | | | | | | | | |
| | Religious Institutions | ✓ | | | | | ✓ | | | | |
| | Public or Section 8 Housing | | ✓ | | | | ✓ | | | | |
| Density | Employment Density | ✓ | | ✓ | | ✓ | ✓ | | ✓ | ✓ | ✓ |
| | Population Density | ✓ | | ✓ | | | ✓ | | ✓ | ✓ | ✓ |
| Land use | Regional Centers / Major Corridors | ✓ | ✓ | | ✓ | | ✓ | | | | |
| | Neighborhood or Commercial Center | | ✓ | | | | | | | | |
| | Suburban Transect Zone | | ✓ | | | | | | | | |
| | Industrial or Medical District | | ✓ | | | | | | | | |
| | Urban Services District | | ✓ | | | | | | | | |
| | Urban Transect Zone | | ✓ | | | | | | | | |
| | Transit Oriented Development (TOD) | | | | | | | ✓ | | | |
| | Land Use Mix | | | | | | | □ | | ✓ | |
| Transit | Transit Access | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Safety | Pedestrian Crashes | ✓ | | | ✓ | | ✓ | ✓ | ✓ | | ✓ |
| Social Assistance | Government Assistance or Social Welfare | ✓ | | | □ | | □ | | ✓ | | |
| Demographics | Senior Population | ✓ | | | | ✓ | ✓ | | ✓ | ✓ | |
| | Health Status | | ✓ | | | | ✓ | | ✓ | | |
| | Automobile Ownership | ✓ | | | | | | | ✓ | ✓ | |
| | Median Household Income | ✓ | | | | | ✓ | | ✓ | | |
| | Equity | ✓ | | | ✓ | | | | | | |
| | Disability Population | ✓ | | | | | | | ✓ | | |
| | Commute Characteristics | ✓ | | | | | | | | | |
| Public Input and Project Considerations | Stakeholder Input | | | | ✓ | ✓ | ✓ | ✓ | | | |
| | Previously Proposed Project (i.e., in an adopted plan) | | | | ✓ | | ✓ | ✓ | | | |
| | Cost | | | ✓ | | | | ✓ | | | |
| | Action (Trade-Off) | | | | | | | ✓ | | | |
| | Opportunity Driven | | | | | | | ✓ | | | |

*Table 1: Peer Cities' Sidewalk Prioritization Criteria (continued)*

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Roadway Characteristics | Street Classification | ✓ | | | | ✓ | ✓ | | ✓ | | |
| | Existing Facilities on Street (including bike lanes) | | | | | ✓ | ✓ | | ✓ | | |
| | Inadequate Infrastructure | | | | ✓ | ✓ | | | | | |
| | Speed Limit | | | | | ✓ | | | ✓ | | |
| | Sidewalk Slope | | | | | ✓ | | | ✓ | | |
| | Buffer Width | | | | | | | | ✓ | | |
| | Curb | | | | | | | | ✓ | | |
| | Length of Block | | | | | | | ✓ | ✓ | ✓ | |
| | Intersection Density | | □ | | | | □ | | | ✓ | |
| | Road Width | | | | | | | | ✓ | | |
| | Crosswalk | | | | | | | | ✓ | | |
| | Curb Ramp | | | | | | | | ✓ | | |
| | Signal Control | | | | | | | | ✓ | | |
| | Stop Sign Control | | | | | | | | ✓ | | |
| | Mitigates Pedestrian / Bicycle / Vehicle Conflicts | | | | | | | ✓ | | | |
| | Connects Off-Street to On-Street Bike Facilities or Sidewalks | | | | | | | ✓ | | | |
| | Public Parking Facilities | | | | | | ✓ | | | | |
| Pedestrian Use and Sidewalk Construction | Evidence of Pedestrian use | | | | | ✓ | | | ✓ | | |
| | Traffic Count | | | | | ✓ | | | | | |
| | Visual Obstructions Present | | | | | ✓ | | | | | |
| | Easement Required to Construct Sidewalk | | | | | ✓ | | | | | |
| | Stormwater / Buffer Concerns | | | | | ✓ | | | | | |
| | Utility Conflicts | | | | | ✓ | | | | | |

# CHAPTER 3: DEVELOPING THE ABSENT SIDEWALK PRIORITIZATION MODEL

## METHODOLOGY

The work detailed in this study began with a review of literature and the study of other cities with a significant number of miles of absent sidewalk infrastructure. In particular, cities with established programs and systems for prioritizing missing sidewalks were reviewed.

Information regarding current City of San Antonio practices in sidewalk prioritization and construction was obtained through conversations with City of San Antonio staff within the Transportation and Capital Improvements Department and the Office of Sustainability. Formal interviews were conducted with four staff through Summer and Fall of 2017, prior to conducting the focus group.[7] Interviews were obtained from these individuals while the author was employed with the City of San Antonio and occurred either via conference call or were done in-person. Initially, it was hoped the prioritization of absent sidewalks would be done as a part of a regional planning effort. Staff from the Planning and Zoning Department, Development Services Department, and Economic Development Department were also consulted regarding sidewalk prioritization. In all, twelve city staff contributed to my knowledge of current practices and acquisition of data.

A premise of this study is that sidewalk prioritization – what criteria are used and the specific scoring weights – should be reflective of community values. It was determined

[7] The staff interviewed included Rebecca Pacini, Shiva Sandrana, Joseph Molina, and Tim Mulry.

that a focus group would be conducted to solicit input regarding criteria for scoring and scoring weights. A Human Subjects Research proposal was submitted for Institutional Review Board consideration and received an "exempt" status. Eight individuals participated in a two-hour facilitated conversation on a Saturday morning in Fall 2017. Through their input, individual criteria, indices, and scoring weights were assembled that provided the foundation for the development of the Absent Sidewalk Prioritization Model. A more detailed discussion of the focus group is provided later.

The prioritization of absent sidewalks was completed using a GIS analysis and data from three sources. First, numerous GIS shapefiles were acquired from City of San Antonio, VIA Metropolitan Transit Agency, and the Texas Department of Transportation.

Second, demographic data were obtained from the U.S. Census Bureau's 2015 American Community Survey (ACS) data five-year estimates. Census tracts were used as the geographic unit of analysis; sample sizes at the census block level are too small to provide reliable estimates. The American Community Survey data were downloaded and joined with Census Tiger line files to perform spatial analysis and to display the data in ArcGIS. The data were used for the Demographic index of the Absent Sidewalk Prioritization Model that considered special needs populations such as seniors, the disabled, those with incomes lower than the median family income for Bexar County, and those who don't have access to a vehicle. Census tracts with a greater number or rate of special needs populations received more points toward the Demographic index score.

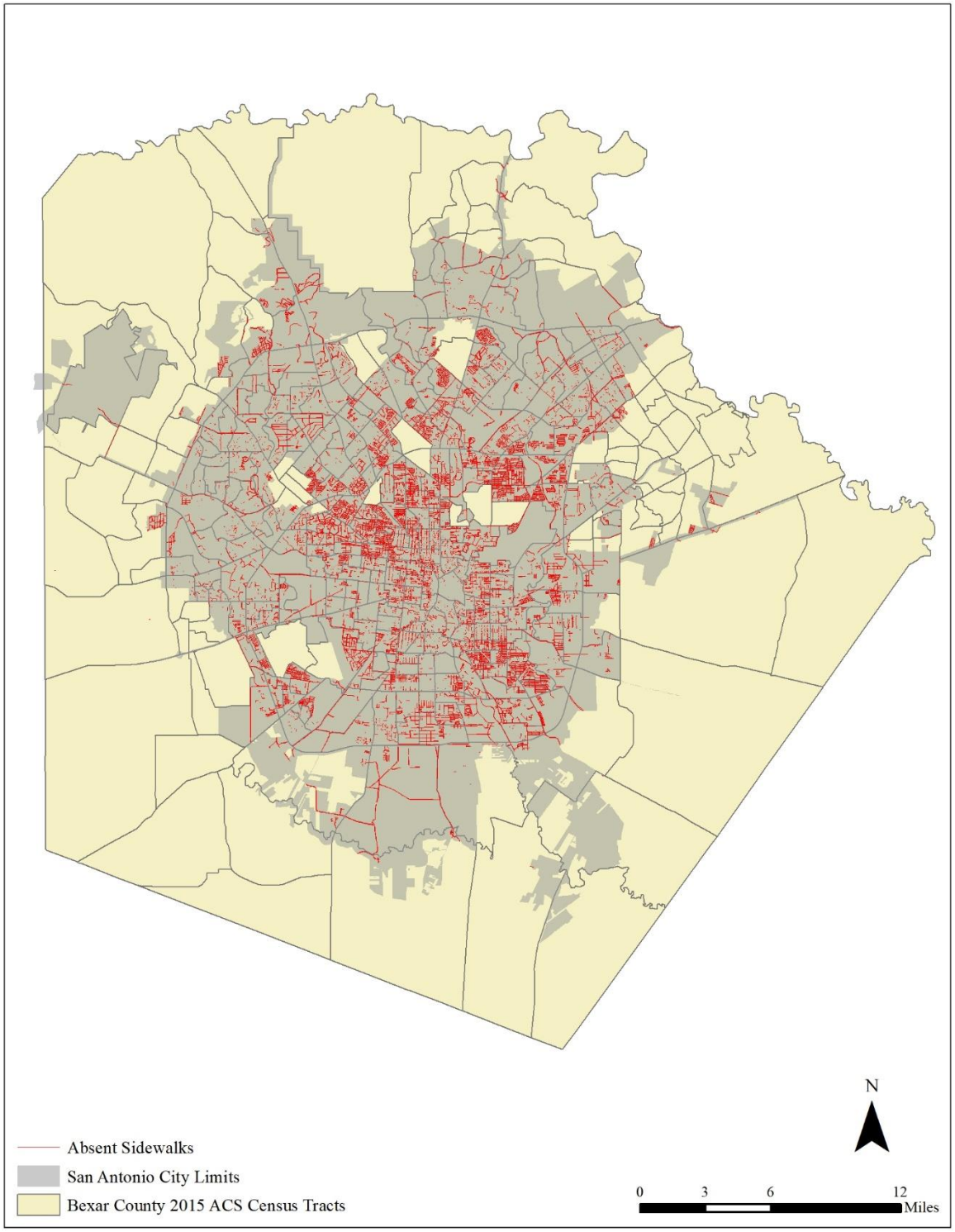
Third, employer size and location data were obtained from ArcGIS Business Analyst. Whereas the most recent ACS data was from 2015, the ArcGIS Business Analyst

data was from 2016. From an initial set of all Texas employers, the data were clipped to the City of San Antonio, including a one-half mile buffer.[8] Other "pedestrian attractors" were extracted from this original dataset by the North American Industry Classification System codes. The data were a part of the data used for the Pedestrian Attractor index. The number of employees within a one-quarter mile buffer of absent sidewalk segments was one criteria of the eleven ultimately used within the Pedestrian Attractor index. Employment is a regular destination for most people of working age. Employer locations were also identified by the focus group. As such, it was considered an important attractor to include in the model.

The analysis for three of the four scoring indices (Policy, Pedestrian Attractors, and Pedestrian Safety / Health) was performed using the City of San Antonio city limits. The remaining index, Demographics, was scored according to census tracts within Bexar County for practicality of analysis and display. The city limits of San Antonio intersect with nearly all census tracts within Bexar County. Further, Bexar County's boundaries capture nearly the entire city limits of San Antonio. The small area of San Antonio that extends beyond Bexar County contains no absent sidewalk segments. The study area of the City of San Antonio and Bexar County can be seen in Figure 2.

[8] Because the absent sidewalk priority scores were based on proximity to destinations, it was important to include destinations outside of the City limits of San Antonio.

*Figure 2: City of San Antonio Absent Sidewalk Study Area*



GIS analysis was performed and displayed using the final Absent Sidewalk Prioritization Model. In general, the model consists of four equally weighted indices comprised of 26 total criteria. Scores were assigned to every one of the more than 29,000 absent sidewalk segments for each criterion evaluated. Three of the four indices (Policy; Pedestrian Attractor; and, Pedestrian Safety / Health) assigned scores to absent sidewalks according to the proximity of features to the missing sidewalks. A quarter-mile Euclidean buffer was used as the default distance of analysis.[9] The fourth index, Demographic, assigned scores to absent sidewalks within census tracts.

The default criteria value was 100 points and increased to a base of 150 if identified by the focus group to be important. Points were assigned to absent sidewalks through a binary system, or through a step-down point system using five classes as the default. In the case of the binary point allocation, if a feature was present within the established area surrounding the absent sidewalk segment, it received full value. If it was not in the established area, it received no points. For criteria where classes were assigned, absent sidewalks were analyzed in GIS using five classes and natural breaks to divide the results. Absent sidewalks belonging to the highest class received full points and each lower class received respectively lower points. A more detailed discussion of the data and scoring follows the presentation of the Absent Sidewalk Prioritization Model.

[9] A quarter-mile distance, about the time it takes a pedestrian 5 minutes to walk, is a standard distance for pedestrian and transit purposes in transportation planning. A one-half mile distance was used as the distance of analysis for SA Corridors as that is the standard used for corridor planning at the City of San Antonio.

## FOCUS GROUP

The focus group was assembled from advertisements to the Alamo Area Metropolitan Planning Organization's (AAMPO) Pedestrian Mobility Advisory Committee, VIA Metropolitan Transit staff, City of San Antonio planning staff within the Planning & Zoning Department and Transportation and Capital Improvements Department, San Antonio Housing Authority staff, staff from the Transportation and Capital Improvements Disability Access Office, Disability SA, and community advocates. Individuals receiving the invitation were free to participate and/or to forward the focus group meeting invitation to others they thought would be interested in participating.

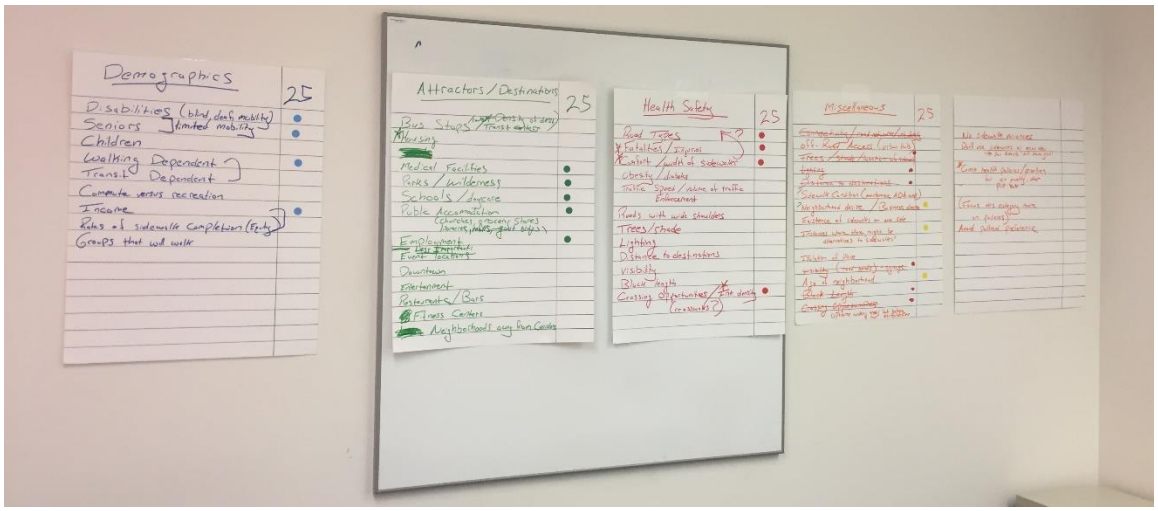
Eight individuals participated in the two-hour focus group on a Saturday morning in Fall 2017. The meeting began with participants reading and agreeing to the Consent to Participate in Focus Group Research, which can be seen in Appendix A. To ensure anonymity, no personal identifying information was asked for or collected. My assessment of the gender, racial/ethnic, and age composition of the focus group participants is speculative. But, the participants were perceived as belonging to the gender, racial/ethnic, and age categories listed in in Table 2.

*Table 2: Composition of Focus Group Participants*

| Gender | Race / Ethnicity | Age |
|---|---|---|
| 4 women<br>4 men | 4 Caucasians<br>3 Latinos<br>1 African American | Early 20s – Early 70s |

Through a two-hour facilitated conversation, seven community members and one city staff identified important elements to consider for prioritizing sidewalks. A discussion guide used to facilitate the focus group can be seen in Appendix B. The first hour was allocated for identifying absent sidewalk scoring criteria. The second hour was allocated for thematic grouping of the identified criteria and for weighting the individual criteria and indices. Large poster boards were used to capture participant comments during the focus group, as seen in Figure 3. Sticker dots were placed next to criteria selected as important within the index.

*Figure 3: Focus Group Input Poster Boards*




Prior to organizing the focus group, significant research was conducted on cities around the country to identify common criteria used for absent sidewalk prioritization. It was expected that many of the same elements would be identified by residents of San Antonio. Approximately one hour was allocated for participants to identify criteria for absent sidewalk prioritization. Toward the end of the first hour, any of the common criteria

from other cities that had not yet been identified by San Antonio residents were introduced by the researcher for consideration. Table 3 displays all the criteria identified/accepted for consideration by the focus group.

*Table 3: Initial Absent Sidewalk Criteria Identified by Focus Group*

| **Initial Absent Sidewalk Criteria** | |
|---|---|
| Disabilities | Transit Dependent Populations |
| Bus Routes | Commuting Versus Recreation |
| Bus Stops | Income |
| Transit Centers | Rates of Sidewalk Completion |
| Density of Destinations | Groups that will Walk |
| Seniors | Housing |
| Children | Medical Facilities |
| Walking Dependent Populations | Parks / Wilderness |
| Churches | Schools |
| Grocery Stores | Daycare |
| Libraries | Event Locations |
| Malls | Downtown |
| Government Buildings | Entertainment Venues |
| Employers | Restaurants |
| Neighborhoods Away from Corridors | Bars |
| Traffic Fatalities | Fitness Centers |
| Traffic Injuries | Obesity / Diabetes |
| Comfort of walking | Traffic Speed |
| Width of Sidewalk | Volume of Traffic |
| Roads with Wide Shoulders | Traffic Enforcement |
| Trees / Shade | Distance to Destinations |
| Lighting | Visibility |
| Crossing Opportunities | Connectivity / Road Network |
| Intersection Density | Off-Road Access (urban trails) |
| Crosswalks | Isolation of Place |
| Neighborhood / Business Desire | Age of Neighborhood |
| Avoid Political Preference | No Sidewalk Variances |
| Block Length | Don't Use Sidewalks as Economic Development |
| Existence of Sidewalks on One Side of Street | Sidewalk Conditions (maintenance, ADA Ramps) |
| Instances Where There Might be Alternatives to Sidewalks | |

The second hour of the focus group was spent developing thematic indices and creating scoring weights for individual criteria as well as the larger indices. Four indices were ultimately created and are displayed in Table 4. Criteria determined by the focus group to be more important are noted.

The focus group comments were largely expected and are consistent with criteria used in the prioritization models of other cities. It was somewhat surprising that transit was passed over as an important criterion within the Pedestrian Attractors index. However, given the low transit ridership in San Antonio, perhaps that should have been expected. The focus group further determined that each index should be considered equally important in the overall absent sidewalk score. Ultimately, the results from the focus group support the use of a public input process in the development of a prioritization model to ensure the selected criteria and assigned scoring weights are reflective of community values.

The results from the focus group largely reflect the final criteria and scoring weights used for the analysis. Some changes were made due to the availability of data. The Pedestrian Attractor index was incorporated into the analysis nearly identical to the focus group recommendation, with heavier scores assigned to the elements identified as most important. Only “neighborhoods away from corridors” was removed from the analysis as the desire to score sidewalks farther from corridors was contradictory to the other criteria. Among the other criteria identified, distance to destinations served as the basis for the Pedestrian Attractors index.

*Table 4: Focus Group Indices and Weighted Criteria*

| **Pedestrian Attractors** | **Pedestrian Safety / Health** |
|---|---|
| **Important Criteria**<br>*** Schools / Daycare**<br>*** Parks / Wilderness**<br>*** Employment**<br>*** Medical Facilities**<br>*** Places of Public Accommodation**<br><br>Other Criteria<br>Transit Routes / Bus Stops<br>Housing<br>Event locations<br>Entertainment Venues<br>Restaurants<br>Bars<br>Fitness Centers<br>Neighborhoods Away from Corridors<br>Distance to Destinations | **Important Criteria**<br>*** Fatality Crashes**<br>*** Injury / Other Crashes**<br>*** Road Types**<br>*** Crossing Opportunities**<br>*** Comfort / Width of Sidewalk**<br><br>Other Criteria<br>Obesity / diabetes<br>Traffic Speed<br>Volume of Traffic<br>Traffic Enforcement<br>Trees / Shade<br>Lighting<br>Visibility<br>Block Length |
| **Demography** | **Miscellaneous** |
| **Important Criteria**<br><br>*** Disabilities**<br>*** Seniors**<br>*** Walking Dependent**<br>*** Transit Dependent**<br>*** Income**<br><br>Other Criteria<br>Commute Versus Recreation Trips<br>Groups That Will Walk | **Important Criteria**<br><br>*** Neighborhood Desire / Business Desire**<br>*** Alternatives to Sidewalks**<br>*** Age of Neighborhood**<br><br>Other Criteria<br>Isolation of Place<br>Sidewalk Condition<br>Existence of Sidewalks on One Side |

The Demographic index was also incorporated into the analysis nearly identical to the focus group recommendations. All of the important criteria identified by the focus group were included. Residential population density was also included as a criterion.

Two criteria identified by the focus group were unable to be included in the analysis. First, because census data only captures commute transportation, the analysis was unable to account for recreational transportation mode choice. Second, there is no direct way to measure for "groups that will walk" with existing data. However, it was determined that the Walk Mode Share and No Car Available categories of the American Community Survey provide proxy measures.

The Pedestrian Safety / Health index ultimately incorporated into the final analysis three of the five important criteria identified by the focus group: Fatal pedestrian crashes; other pedestrian crashes; and primary arterial, minor arterials, collector and local road types as classified using Texas Department of Transportation's functional classification. The Sidewalk GIS shapefile does not list sidewalk width, so that criterion was unable to be used. Among the other criteria identified, many were excluded from the analysis due to unavailability of data. Obesity data was sought from the Metropolitan Health District, but no response was provided to my data inquiry. Trees and shade, lighting, and visibility also do not exist as available data sources. It was determined that road classification would serve as reasonable proxy measurements for speed and traffic volume due to the direct association of larger roads to volume of traffic and higher posted speed limits.

The greatest modifications to the focus group recommendations occurred to the Miscellaneous index. None of the criteria identified by the focus group were included in the analysis. Data do not currently exist to score for "neighborhood desire / business desire," whether "alternatives to sidewalks" exist for a specific site, or for "sidewalk condition." Developing these criteria have merit but were beyond the scope of this study.

Though data do not exist collectively for neighborhood and business desire regarding sidewalks, the sidewalk GIS shapefile does indicate a category of "undesired" sidewalks relating to neighborhood opposition to sidewalk construction. This designation was not included in the model for two reasons. First, the assessment of sidewalk needs should be considered formally and consistently across the entire city. The designation in its current form lacks necessary information regarding the extent of neighborhood opposition, particular geographic extents, and whether every neighborhood was allowed an equal opportunity to voice support or opposition for sidewalk construction. In the absence of these details, the dataset is unreliable and introduces elements of inequity into a formal planning tool which is unacceptable. Second, the Americans with Disabilities Act mandates accessibility. Neighborhood and homeowner opposition to sidewalk construction should not influence a formal assessment of sidewalk needs and priorities according to adopted criteria.

Much of the focus group discussion related to equity of sidewalk construction. It was suggested that older neighborhoods that have been waiting for sidewalks the longest be prioritized. Proxy measurements for social equity were achieved through both income and commute mode.

The decision was made to exclude from the analysis the presence of sidewalks on one side of the street. It is a criterion in other cities. The justification for inclusion relies upon the assumption that the presence of a sidewalk on one side of the street provides for mobility and lessens the priority to complete sidewalk construction for the other side of that same street. Unfortunately, due to the inadequate level of ADA curb ramps in San

Antonio, and ability to assess for crossing opportunities, the presence of a sidewalk on one side of a street likely does not satisfy mobility requirements. A more robust dataset of existing sidewalk conditions, ADA curb ramp locations, ADA access across medians, etc. will in the future enable the inclusion of this additional criterion.

Rather than advance a miscellaneous index into the final analysis, a Policy index was created to recognize the comprehensive plan's vision for walkable communities within regional centers and within one-half mile of corridors. The focus group chose to exclude other city policy priorities from the model.

### ABSENT SIDEWALK PRIORITIZATION MODEL

The final criteria and scores used for absent sidewalk prioritization are found in Table 5. The absent sidewalk scores were joined and displayed in ArcGIS.

*Table 5: Absent Sidewalk Prioritization Model*

| Absent Sidewalk Prioritization Model | | | | |
|---|---|---|---|---|
| **Final Scores (0-400 points)**<br><br>201.2- 309.5 (Very High Priority)<br>154.6 - 201.1 (High Priority)<br>110.2 - 154.5 (Medium Priority)<br>66.8 - 110.1 (Low Priority)<br>3.6 - 66.7 (Very Low Priority) | | | | |
| **Policy Score (0-100 points)** | | | | |
| | | **Points** | | **Data Source** |
| **Element** | **Criteria** | **Yes** | **No** | |
| SA Tomorrow Regional Centers | *Presence within a SA Tomorrow Regional Center* | 50 | 0 | City of San Antonio SA Tomorrow Regional Center shapefile |
| SA Tomorrow Corridors | *Presence within 1/2 mile of a SA Tomorrow Corridor* | 50 | 0 | City of San Antonio SA Tomorrow Corridors shapefile |

*Table 5: Absent Sidewalk Prioritization Model (continued)*

| Demographic Score (0-100 points) | | | |
|---|---|---|---|
| **Element** | **Criteria** | **Points** | **Data Source** |
| Residential Population Density | *Number of people per square mile* | | 2016 Business Analyst |
| | a) 7,900.6 – 14,727.2 | 100 | |
| | b) 5,746.6 – 7,900.5 | 75 | |
| | c) 3,799.4 – 5,746.5 | 50 | |
| | d) 1,722.8 – 3,799.3 | 25 | |
| | e) 0.0 – 1,722.7 | 0 | |
| | | | |
| Median Household Income | *Number of households with household income < $50,000.00* | | 2015 American Community Survey Table B19001 Household Income in the Past 12 Months (In 2015 Inflation-Adjusted Dollars) |
| | a) 1,599 – 2,737 | 100 | |
| | b) 1,142 – 1,598 | 75 | |
| | c) 737 – 1,141 | 50 | |
| | d) 379 – 736 | 25 | |
| | e) 0 – 378 | 0 | |
| | | | |
| Number of Disabled | *Estimated number of disabled persons* | | 2015 American Community Survey Table DP02 Selected Social Characteristics in the United States |
| | a) 1,138 – 1,753 | 100 | |
| | b) 823 – 1,137 | 75 | |
| | c) 560 – 822 | 50 | |
| | d) 305 – 559 | 25 | |
| | e) 0 – 304 | 0 | |
| | | | |
| Seniors | *Estimated percent of people 65 years and older* | | 2015 American Community Survey Table S0101 Age and Sex |
| | a) 33.1 – 86.1 | 100 | |
| | b) 19.1 – 33.0 | 75 | |
| | c) 13.1 – 19.0 | 50 | |
| | d) 8.2 – 13.0 | 25 | |
| | e) 0.0 – 8.1 | 0 | |
| | | | |
| No Car Available | *Percent of working population age 16 years and over with no car available* | | 2015 American Community Survey Table S0801 Commuting Characteristics by Sex |
| | a) 17.5 – 26.1 | 100 | |
| | b) 9.9 – 17.4 | 75 | |
| | c) 5.6 – 9.8 | 50 | |
| | d) 2.2 – 5.5 | 25 | |
| | e) 0.0 – 2.1 | 0 | |

*Table 5: Absent Sidewalk Prioritization Model (continued)*

| | | | | |
|---|---|---|---|---|
| Walk Mode Share | *Percent of working population age 16 years and over that walk to work* | | | 2015 American Community Survey Table S0801 Commuting Characteristics by Sex |
| | a) 14.3 – 38.4 | 100 | | |
| | b) 7.4 – 14.2 | 75 | | |
| | c) 3.4 – 7.3 | 50 | | |
| | d) 1.2 – 3.3 | 25 | | |
| | e) 0.0 – 1.1 | 0 | | |
| | | | | |
| Transit Mode Share | *Percent of working population age 16 years and over that use transit to commute to work* | | | 2015 American Community Survey Table S0801 Commuting Characteristics by Sex |
| | a) 13.0 – 19.7 | 100 | | |
| | b) 7.5 – 12.9 | 75 | | |
| | c) 4.2 – 7.4 | 50 | | |
| | d) 1.6 – 4.1 | 25 | | |
| | e) 0.0 – 1.5 | 0 | | |
| | | | | |
| **Pedestrian Attractor Score (0-100 points)** | | | | |
| **Element** | **Criteria** | **Points** | | **Data Source** |
| Employer density | *Number of employees within 1/4 mile of absent sidewalk segment* | | | |
| | a) 4,735.1 – 2,0442.0 | 150 | | 2016 Business Analyst - all data |
| | b) 2,038.1 – 4,735.0 | 112.5 | | |
| | c) 941.1 – 2,038.0 | 75 | | |
| | d) 331.1 – 941.0 | 37.5 | | |
| | e) 0.0 – 333.0 | 0 | | |
| | | | | |
| | | **Yes** | **No** | |
| VIA High Capacity Transit Route | *Presence within 1/4 mile of high capacity transit route* | 100 | 0 | VIA Rapid Transit Network shapefile |
| VIA Local Transit Route | *Presence within 1/4 mile of local route* | 50 | 0 | VIA Local Routes shapefile |
| | | | | |
| **Places of Public Accommodation** | | | | |
| Schools (Elementary; Junior High; High School; Junior College; College; University) | *Presence within 1/4 mile of a public school* | 150 | 0 | City of San Antonio Public Schools shapefile and 2016 Business Analyst - North American Industry Classification System Codes 6111, 6112, 6113 |
| Parks / Trails / Trail Heads | *Presence within 1/4 mile of a park, trail, or trail head* | 150 | 0 | City of San Antonio Park Boundaries, Trails, and Trail Heads shapefiles |

*Table 5: Absent Sidewalk Prioritization Model (continued)*

| | | | | |
|---|---|---|---|---|
| Places of Worship | *Presence within 1/4 mile of a place of worship* | 150 | 0 | 2016 Business Analyst - North American Industry Classification System Code 813110 |
| Grocery Stores | *Presence within 1/4 mile of a grocery store* | 150 | 0 | 2016 Business Analyst - North American Industry Classification System Code 44511 |
| Libraries | *Presence within 1/4 mile of a public library* | 150 | 0 | City of San Antonio Libraries shapefile |
| Shopping Centers / Malls | *Presence within 1/4 mile of a shopping center / mall* | 150 | 0 | 2016 Business Analyst - North American Industry Classification System Code 53112008 |
| Spectator Venues (Aquariums; Amphitheaters; Arenas; Convention Center; Museums; Performing Arts Centers; Planetarium; Stadiums; Movie Theaters; Zoos) | *Presence within 1/4 mile of a spectator venue* | 150 | 0 | City of San Antonio Public Assembly shapefile, 2016 Business Analyst - North American Industry Classification System Code 71211001 |
| Hospitals (622) | *Presence within 1/4 mile of a hospital* | 150 | 0 | 2016 Business Analyst - North American Industry Code 622 |
| | | | | |
| Government (City of San Antonio Offices; Legislative Bodies; Other Government Support; Courts; Legal Counsel and Prosecution; Parole Offices and Probation Offices; Administration of Public Health Programs - Health Departments; Administration of Human Resource Programs - Social Services; Administration of Veteran's Affairs) | *Presence within 1/4 mile of a government office* | 100 | 0 | Selections from City of San Antonio Facilities Shapefile, 2016 Business Analyst - North American Industry Codes 92112, 92119, 92211001, 92211002, 92211004, 922130, 92215, 92312004, 92313001, 92314) |

*Table 5: Absent Sidewalk Prioritization Model (continued)*

| | | | | |
|---|---|---|---|---|
| Health (Physicians' Offices; Dentists Offices; Offices of Other Health Care Practitioners; Outpatient Care Centers; Nursing Care Facilities; Continuing Care Retirement Communities and Assisted Living Facilities for the Elderly; Other Residential Care Facilities) | *Presence within 1/4 mile of a health-related facility (except hospitals)* | 100 | 0 | 2016 Business Analyst - North American Industry Classification System codes 62111, 6212, 6213, 6214, 62311, 62331, 623990 |
| | | | | |
| Social Assistance (Community Food and Housing; Emergency and Other Relief Services; Vocational Rehabilitation Services; Employment Placement Agencies; Temporary Help Services) | *Presence within 1/4 mile of a social assistance facility* | 100 | 0 | 2016 Business Analyst - North American Industry Classification System Codes 6242, 6243, 561311, 56132001) |
| | | | | |
| Retail (Restaurants and Other Eating Places; Drinking Places; Convenience Stores; Specialty Food Stores; Beer, Wine, and Liquor Stores; Department Stores; General Merchandising Stores; Miscellaneous Store Retailers; Fitness and Recreation Sports Centers; Health and Personal Care Services; Clothing and Clothing Accessories Stores; Sporting Goods; Hobby, Musical Instrument, and Book Stores) | *Number of retail establishments within 1/4 mile of absent sidewalk* | | | 2016 Business Analyst - North American Industry Classification System Codes 7225, 7224, 44512, 4452, 4453, 4521, 452210, 4522, 4523, 453, 713940, 446, 448, 451 |
| | a) 109 – 155 | 100 | | |
| | b) 51 – 108 | 75 | | |
| | c) 17 – 50 | 50 | | |
| | d) 6 – 16 | 25 | | |
| | e) 0 – 5 | 0 | | |
| | | | | |
| **Pedestrian Safety / Health Score (1-100 points)** | | | | |
| **Element** | **Criteria** | **Points** | | **Data Source** |
| Fatalities and Serious Injuries | *Number of fatal and serious crashes in the past 5 years within 1/4 mile of absent sidewalk segment* | | | Texas Department of Transportation CR3 Crash Report Data |
| | a) 6 – 8 | 150 | | |
| | b) 4 – 5 | 140 | | |
| | c) 2 – 3 | 130 | | |
| | d) 1 | 120 | | |
| | e) 0 | 0 | | |

*Table 5: Absent Sidewalk Prioritization Model (continued)*

| | | | |
|---|---|---|---|
| Minor Pedestrian Crashes (minor injuries / no injuries / unknown injuries) | *Number of minor crashes in the past 5 years within 1/4 mile of absent sidewalk segment* | | Texas Department of Transportation CR3 Crash Report Data |
| | a) 18 – 34 | 100 | |
| | b) 10 – 17 | 75 | |
| | c) 5 – 9 | 50 | |
| | d) 2 – 4 | 25 | |
| | e) 0 – 1 | 0 | |
| | | | |
| Street Classification | *TXDOT Functional Classification* | | City of San Antonio Streets shapefile |
| | Principal Arterial | 100 | |
| | Minor Arterial | 75 | |
| | Collector | 50 | |
| | Local | 0 | |

The Absent Sidewalk Prioritization Model was used as the basis for GIS analysis which was performed using a variety of approaches. The Policy index was scored according to whether any portion of an absent sidewalk segment is within a regional center or within a half-mile Euclidean buffer of a SA Tomorrow Corridor. A half-mile buffer is the standard used by the City of San Antonio for evaluating zoning decisions within SA Tomorrow Corridors and for corridor studies.[10]

The Demographic index evaluated absent sidewalks according to the prominence of special needs populations within census tracts. All census tracts in Bexar County were scored relative each other using five classes and sorted using natural breaks classification. Every absent sidewalk segment within a census tract received the same score. In instances

[10] The author is a former employee of the San Antonio Planning Department.

where absent sidewalk segments straddled multiple census tracts, the absent sidewalk segment received the higher of the census tract scores.

The Pedestrian Attractor index was scored primarily using a quarter-mile Euclidean batch buffer of absent sidewalk segments. Absent sidewalks received a score for each pedestrian attractor criteria if a facility was present within the absent sidewalk buffer. This is a binary score – facilities are present or not. The presence of multiple facilities (e.g., multiple schools) does not increase the score except in two instances: Employer density and number of retail establishments. Employer density and number of retail establishments were scored according to the *number* of jobs and establishments within the one-quarter mile buffer of each absent sidewalk segment. The number of jobs and retail establishments were sorted into five classes using natural breaks classification.

The Pedestrian Safety / Health index was developed using five years of crash data. Pedestrian traffic fatalities and series injuries,[11] and other pedestrian crashes were analyzed according to quarter-mile Euclidean buffers and sorted into five classes by the number of events which occurred using natural breaks classification. The street classification component was scored according to the presence of primary arterial, minor arterial, collector, and local street types as classified by Texas Department of Transportation's (TXDOT) functional classification, within one-quarter mile buffer of each absent sidewalk segment. In instances where an absent sidewalk segment is within one-quarter mile of more than one street type, the absent sidewalk segment received the highest score.

[11] "Serious injuries" is a term used interchangeably with those listed as "incapacitating injury" within TXDOT's Crash Records Information System (CRIS).

The focus group recommended each of the four indices be valued equally, one-fourth of the total absent sidewalk score. The indices contained different numbers of elements, though, and per the focus group's input various elements were given more weight within the indices. Each index score was derived by adding all element scores and dividing by the maximum possible score. That percentage was multiplied by 100 creating an absent sidewalk score for each index worth 100 points. The highest total absent sidewalk score possible is 400 points.

## DISCUSSION AND LIMITATIONS

The methodology used to perform the analysis for this report contains several limitations worth noting. First, the entire Demographic index and its score is limited by reliance upon American Community Survey data, which is subject to sampling error. Full population counts would have yielded superior demographic data for this analysis. However, the last decennial census completed in 2010 is seven years old and between 2010 and 2017 San Antonio has experienced significant population growth (MIG and City of San Antonio 2016). Other demographic shifts have likely occurred within the city, too, that would negatively affect the quality of the findings. For this reason, it was determined that 2011-2015 American Community Survey data would be more appropriate for this analysis despite the fact that the data used are only samples of the population rather than full population counts. Because American Community Survey data is made available in five-year population estimates and at larger geographic units of analysis (tracts versus blocks), the effects of small sample sizes are somewhat mitigated.

The dynamic nature of cities further justifies the use of American Community Survey data. A city's development patterns, shifts in residential population, and emerging economic centers (e.g., job and retail locations and concentrations) are all factors that should influence infrastructure prioritization and construction. These factors should be accounted for in updated prioritization plans more regularly than can be achieved using the decennial census. The American Community Survey provides quality data annually that is readily available for every level of government.

The specific American Community Survey data tables used for Demographic index also merits discussion. Six of the Demographic index components could have been expressed as absolute population estimates or as rates: Median Household Income; Disability; Seniors; No Car Available; Walk Mode Share; Transit Mode Share). Generally, it is thought preferable to use a rate versus absolute numbers when dealing with census data because the population size of census tracts can vary. A rate provides a way to express the prevalence of a social characteristic while insulating it from the effect of population size.

This author's experience working in Vision Zero, a movement to eliminate traffic fatalities and serious injuries, strongly suggests that a rate approach can also be problematic. Using transportation safety as an example, engineers evaluate the safety of an intersection or street segment according to fatality rates, addressing those that are anomalously high. However, if the goal is to eliminate traffic fatalities and serious injuries, it is the absolute number that is of concern. A street with a higher traffic volume may have a lower fatality rate while still producing a higher number of deaths than a street with a

higher fatality rate.[12] From the standpoint of eliminating fatalities, it is more justifiable to focus on the higher absolute counts, regardless of the rate. This same logic could be applied to prioritizing absent sidewalks. The incorporation of demographic data was an acknowledgement that there are segments of the population more in need of sidewalk infrastructure. Absolute numbers can more directly reflect the number of special needs populations than a rate. Where a rate can help protect against penalizing a census tract with lower population, an absolute count can help to avoid larger special needs populations being diluted in a census tract with a larger population.

Ultimately, this author selected data tables that used rates for four of the six Demographic index components and data tables that used absolute numbers for two of the six Demographic index components. American Community Survey Table DP02 Selected Social Characteristics in the United was chosen to reflect prevalence of disabilities and it uses absolute numbers as opposed to a rate. Table S1810 Disability Characteristics was considered for use, but it was dismissed after an initial review failed to show a total disability category as a rate. It does display absolute numbers and rates separately for multiple disabilities. But, there was concern that the separate disability categories would result in overcounts if individuals had more than one disability. For that reason, a table with absolute numbers was chosen. It wasn't until after the completion of the study that the author discovered that Table S1810 Selected Social Characteristics in the United States *does* display total disabilities and does so using a rate.

[12] It is a fundamental tenet of Vision Zero that street design is a cause of death in the same way that intoxication or distraction are causes of traffic deaths.

Table B19001 Household Income in the Past 12 Months (In 2015 Inflation-Adjusted Dollars) which uses absolute numbers was selected to reflect the closest achievable approximation to Median Family income for Bexar County. Alternatively, Table S1901 Income in the Past 12 Months (In 2015 Inflation-Adjusted Dollars would have expressed the same income as rates. Ultimately, the selected tables expressing absolute numbers and rates are defensible. However, future iterations of absent sidewalk prioritization should be consistent in the use of absolute numbers or the use of rates.

The second limitation to this study is the use of Euclidean buffers. Euclidean buffers measure a defined distance along a straight line from a point. In other words, a simple circle is drawn around a point of around using a defined distance as the radius. This approach does not accurately reflect pedestrian paths or a pedestrian's distance traveled. Therefore, scores assigned for pedestrian attractors are approximations of amenities and services nearby each absent sidewalk segment.

Network analysis may be a slightly superior method for determining pedestrian travel routes and distances. Network analysis operates by evaluating for a distance from an origin point according to a defined path, such as along a street network.[13] A network analysis trial was performed to determine the number of businesses within a quarter-mile network buffer of each absent sidewalk segment within the Midtown Regional Center, a small portion of the overall city's geographic area. After 14 hours of runtime, the analysis had not yet completed. This trial was performed several times using multiple computer

[13] A network analysis requires the origin to be a point feature in GIS. A feature-to-point conversion was performed in ArcGIS in order to convert the absent sidewalk line segments into points.

platforms. The processing demands of a network analysis were too onerous for even a small portion of the city. Research by Guerra et al. support the use of Euclidean buffers, finding, too, that they entail significantly less upfront data-collection than network buffer analysis with little to no difference in the results (Guerra 2012, 102). For these reasons, a simpler Euclidean analysis was used for this study.

A third limitation of the study is incomplete data within the datasets used to determine absent sidewalk scores. American Community Survey data was unavailable for four census tracts for at least one of the component scores within the Demographic index. All of the Demographic component scores affected by missing census tract data are shown in Appendix C.

Missing data is a problem that must be evaluated and addressed. The degree to which missing data may affect the overall absent sidewalk score is determined by the quantity of missing data as well as the specific weight of the criteria which are missing. Overall, the impression was the four census tracts possessed very few sidewalks. GIS analysis confirmed there are only 20 miles of missing sidewalks within these tracts, or less than 0.009% of all missing sidewalks within San Antonio.

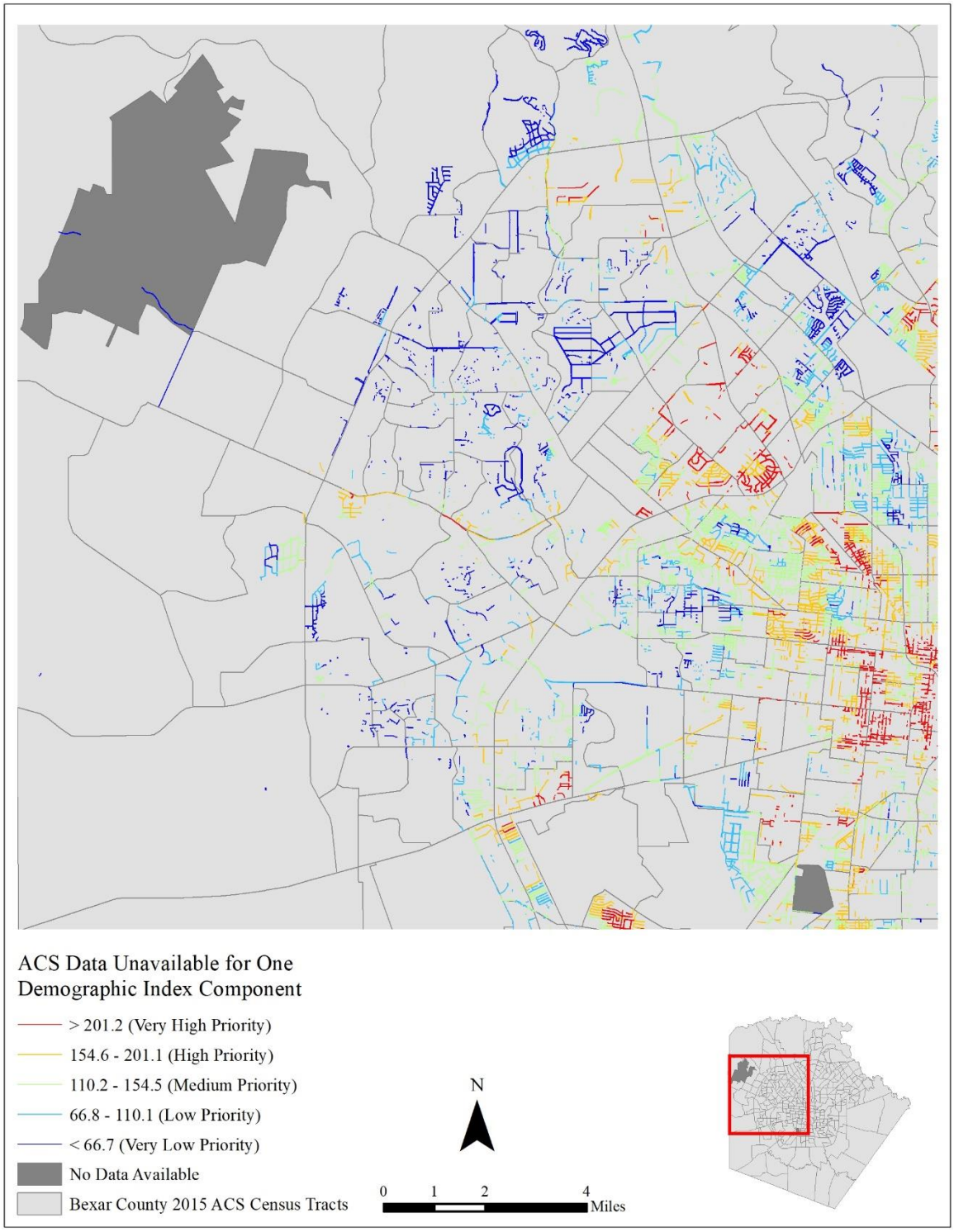
Two census tracts containing 4.4 miles of absent sidewalk are missing data for only one of the seven Demographic index component scores: Number of Households Below $50,000 Annual Income. Because all Demographic components were weighted equally for scoring purposes, the missing component represents, at most, 14 points toward the overall

absent sidewalk score for missing sidewalks within these tracts.[14] Figure 4 displays the census tracts affected by missing American Community Survey data for the number of households earning below $50,000. The missing sidewalks within these tracts contain nearly exclusively "Low Priority" and "Very Low Priority" sidewalks. Increasing the absent sidewalk scores by the maximum possible points for the missing data would not elevate the missing sidewalk segments of these two census tracts to "High Priority" or "Very High Priority" classification.[15]

[14] Demographic index component scores were assigned to missing sidewalks in a census tract according to how the census tracts performed relative each other.

[15] If the Demographic data weren't missing and additional points were allocated to the absent sidewalks in these four census tracts, it is possible the break points for absent sidewalk classes would shift slightly.

*Figure 4: ACS Data Unavailable for Households Below $50,000 Income*



The other two census tracts with unavailable ACS data are missing data for five of the seven Demographic index component scores: Number of Households Below $50,000 Annual Income; Percentage of Households with a Senior (65+); Percentage of Working Population without Access to a Vehicle; Walking Commute Rate; and, Transit Commute Rate. The quantity of unavailable data, in this case, represents a more significant potential impact on the overall absent sidewalk scores. The missing data represents 71.4 of the potential 100 points for the Demographic index score. Figure 5 displays the two census tracts missing American Community Survey data for the Demographic index components. There are 16 miles of absent sidewalk within these census tracts. Even without the potential points from more complete demographic data, three miles of absent sidewalks already achieve "High Priority" classification. Only four other miles of missing sidewalk could achieve "High Priority" or "Very High Priority" under the most optimistic scoring scenarios. The remaining nine miles of absent sidewalk would be unable to achieve classification higher than "Medium Priority."

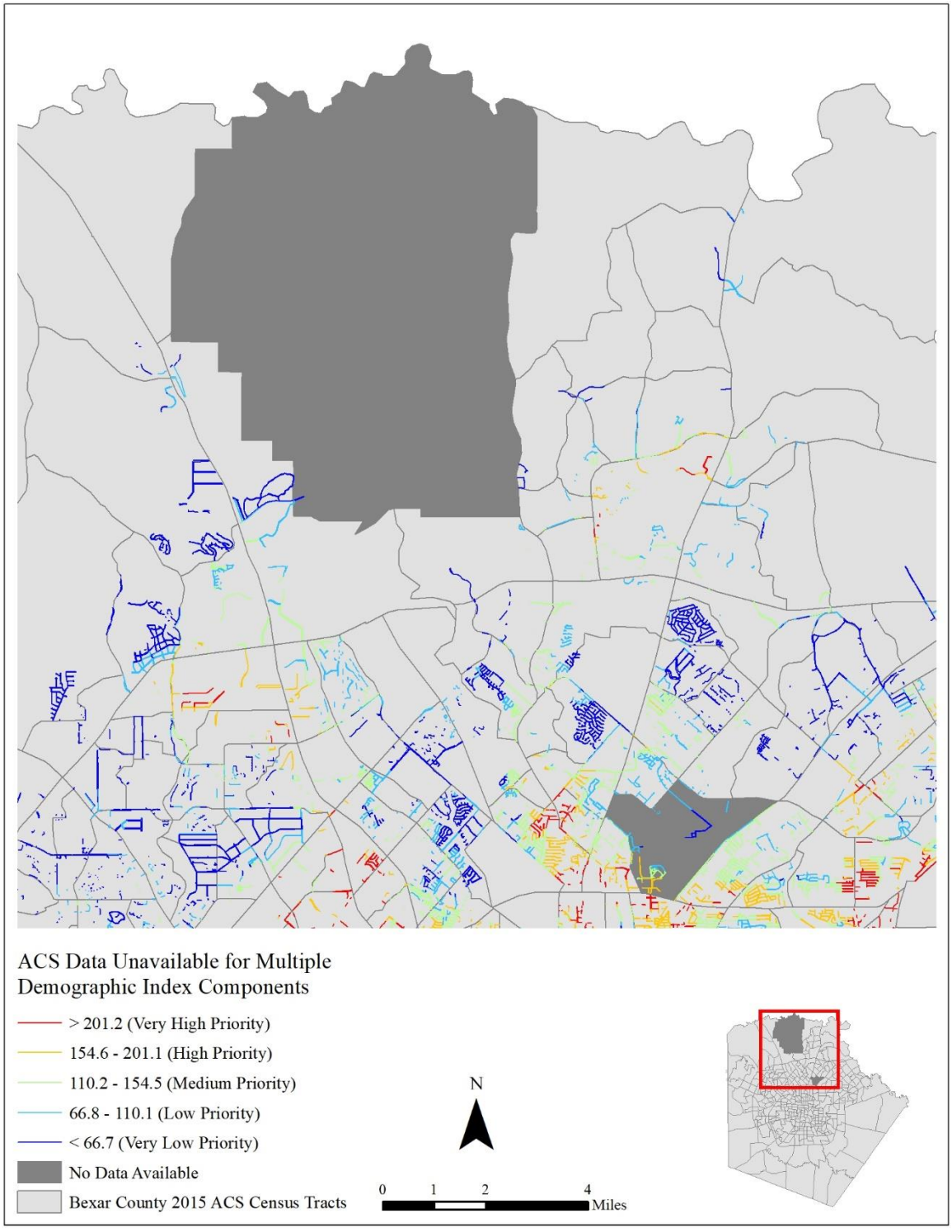
A further consideration for how – or whether – to mitigate the impact of missing data on absent sidewalk scores is the expected frequency of performing absent sidewalk scoring. In other words, how often will the prioritization matrix be run to assign absent sidewalk prioritization scores. It is recommended that the absent sidewalk prioritization analysis be performed again using the 2020 Decennial Census data once it is available. This will eliminate issues associated with missing demographic data and will establish a pattern of 10-year updates using full census data. It is also recommended that the analysis

be performed at least once in between decennial censuses to correct for demographic, safety, and economic shifts throughout the city.

Ultimately, due to the incredibly small portion of sidewalks affected by missing data, the negligible impact on absent sidewalk scores, and the intention that the maps produced for this study to have a useful life of only a few yearseco, no strategy was devised or applied to mitigate the scoring impact resulting from missing data. Absent sidewalks within census tracts where data was unavailable received a score of zero for the respective demographic components.

In the future, missing demographic data may affect a greater share of sidewalks and affect scoring to a greater degree than was experienced in this study. In that case, attempts should be made to mitigate the negative impact of missing points from the overall prioritization score. One approach could be to classify or assign a score to the census tract with missing data – and all missing sidewalks contained within it – equal to the average score of adjacent census tracts.

*Figure 5: ACS Data Unavailable for Multiple Demographic Index Components*



Other data limitations were observed. Supervisors within the City of San Antonio Information Technology Services Department confirmed many GIS shapefiles uploaded to the city's internal servers, and in use by city staff, are not maintained.[16] It is this author's opinion that the quality of data within San Antonio is a major barrier to superior planning efforts. One aim of this study is to help identify those datasets which are necessary for sidewalk prioritization in order that the quality of those datasets can be improved.

The Business Analyst data used for most of the Pedestrian Attractors' index components was also revealed to be incomplete. However, it is unrealistic to expect any dataset to be entirely accurate and ArcGIS's Business Analyst makes use of a leading vendor of business data (Esri 2018). For this reason, it was determined to be a quality dataset.

Where conspicuous gaps in data were identified within the datasets, either the City of San Antonio or Business Analyst shapefiles, a decision was made as to the superior dataset. That dataset was then supplemented by other data when duplicate data could be eliminated. Beyond attempts to combine multiple datasets, no additional efforts were made to improve the datasets used in this study. The quantity of the data used for this study made such a task unfeasible.

The limitations posed by incomplete and inaccurate datasets are a continual challenge to planning efforts. The quality of San Antonio's GIS shapefiles can surely be improved but is probably typical of the quality of data available within many municipalities

[16] The conversations with Information Technology Services staff took place while the author was employed for the City of San Antonio and were related to work projects. However, the data quality issues that the conversations revealed pertain to sidewalk prioritization.

across the country. And, the American Community Survey and the ArcGIS Business Analyst are regarded as quality datasets, whatever imperfections exist. No dataset will ever be perfect, and it is this author's contention that imperfect data should not be allowed to impede planning efforts and decision-making. The work of a municipality should progress with best available data and efforts made to improve the quality of data over time. The Absent Sidewalk Prioritization Model, and the criteria on which it is based, are the shapefiles and datasets San Antonio should work to improve.

# CHAPTER 4: FINDINGS

## ABSENT SIDEWALK PRIORITIZATION SCORING RESULTS

The Absent Sidewalk Prioritization Model uses ArcGIS to generate a five-tier prioritization system for all absent sidewalk segments throughout the city of San Antonio. The Absent Sidewalk Prioritization Model is a weighted sum model variant of Multi-Criteria Decision Analysis; it is built on four indices, inclusive of 26 separate criteria, and with values weighted according to community and professional input. Figures 6-9 show the individual index scores from the Absent Sidewalk Prioritization Model. Figure 10 shows the composite absent sidewalk priorities across the city. Absent sidewalk priorities can be seen in more detail through the map series in Appendix D.

The Absent Sidewalk Prioritization Model analysis produced mostly expected outcomes. The Policy index results shown in Figure 6 generated prioritization scores in only three classes because there were only two criteria included. The highest priority sidewalks show the overlap of the SA Tomorrow Regional Center and Corridors and clearly depict the highest priority land areas for developed walkable, mixed-use, and transit-rich places within San Antonio. Because the areas for regional centers and corridors were already established, the results of the Absent Sidewalk Prioritization Model Policy index were expected.

The Demographic index results shown in Figure 7 reveal a concentration of the highest priority sidewalks within the inner loop bounded by I-410. Typical metropolitan patterns of suburban affluence and urban poverty, residential density, walking mode share, and transit mode share are consistent with the findings. In short, individuals who rely upon

walking require the land use patterns and greater transit provision of central cities. Emphasizing construction of missing sidewalks in the inner city is logical from the standpoint of providing the requisite infrastructure to those who are most in need and most likely to use it. The reliance on census tracts generates less variation in scores than will be the case through census block data available with the 2020 Decennial Census.

The results of the Pedestrian Attractors index shown in Figure 8 were somewhat unexpected. The range of scores generated for the Pedestrian Attractors index were much smaller than the other indices. Where the other three indices produced absent sidewalk priority scores in the 50s, at least, for the highest priority absent sidewalks, and in the 80s in the case of the Pedestrian Safety / Health index, the Pedestrian Attractors scores produced scores as low as 29 out of a possible 100 for the highest priority absent sidewalks. The highest priority sidewalks were still concentrated within the inner loop, similar to the other indices, supporting the assumption that the central city would likely contain a higher concentration of major employers, cultural and government facilities, and retail establishments. The greater uniformity of the Pedestrian Attractors index scores is likely attributable to the generally sprawled land use patterns of San Antonio. Automobile orientation decentralizes pedestrian destinations.

The Pedestrian Safety / Health index shown in Figure 9 reveals a high concentration of pedestrian crashes West and Northwest of downtown straddling council districts 1, 5, and 7. The inclusion of other safety and health criteria into the index would have masked this pronounced concentration of traffic safety needs. But, other community health issues

likely exist such as areas of San Antonio with especially high rates of obesity that may be aided by greater sidewalk infrastructure.

The composite absent sidewalk prioritization scores are shown in Figure 10. Most significantly, the Absent Sidewalk Prioritization Model succeeded in producing a large range of priority scores across a five-tier classification system. The large variation in absent sidewalk scores provides assurance that the missing sidewalks identified as “High Priority” and “Very High Priority” are, in fact, substantially different in merit than absent sidewalks receiving lower scores. Further confidence in the final prioritization scores should be derived from reliance on community input and professional best practices.

San Antonio’s current practice of prioritizing absent sidewalks according to their proximity to schools and hospitals lacks the robustness of the model developed through this study. And, due to the limited criteria considered, the current practice is inherently limited in the range of scores which can be generated.

*Figure 6: City of San Antonio Policy Index Scores*

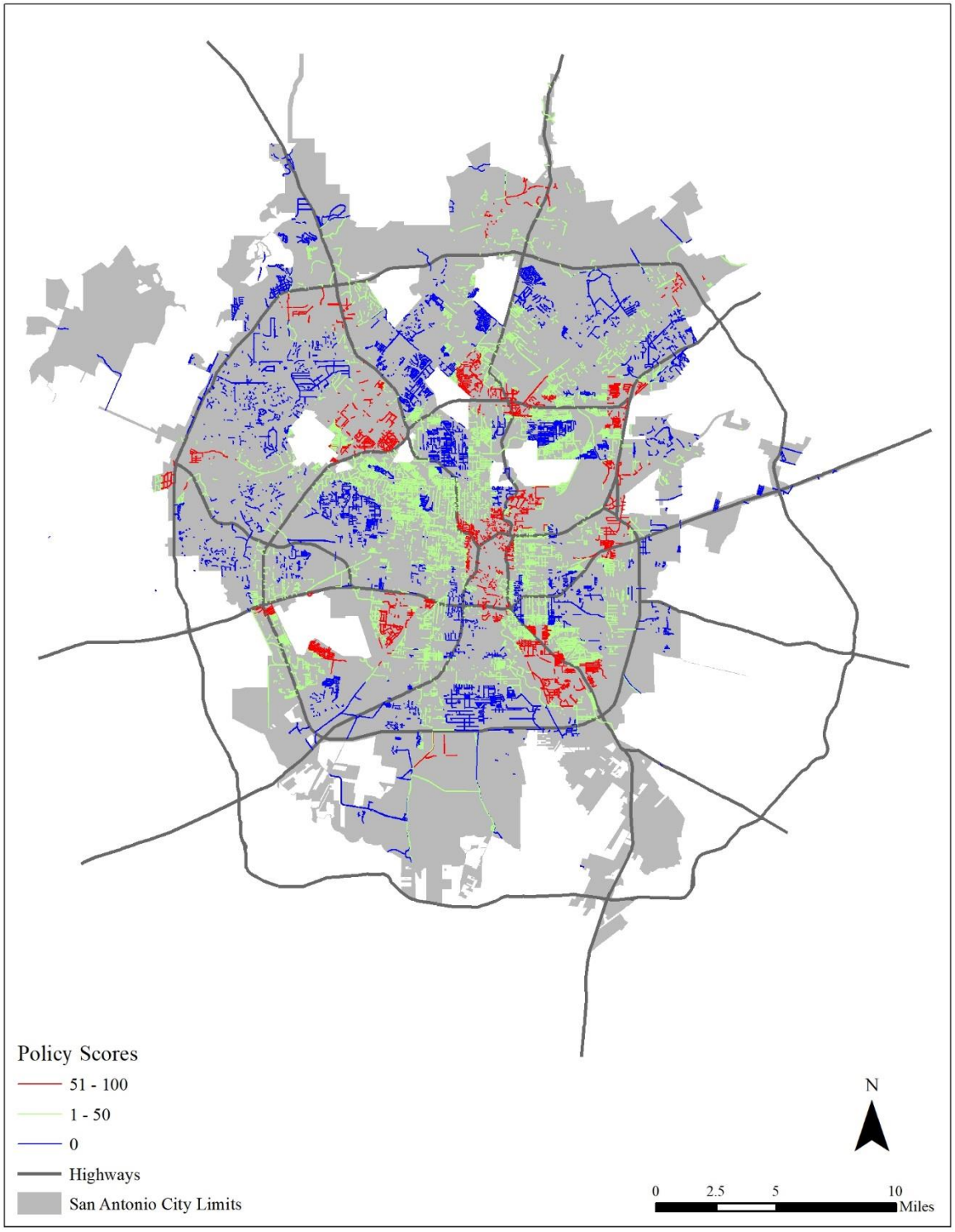


*Figure 7: City of San Antonio Demographic Index Scores*

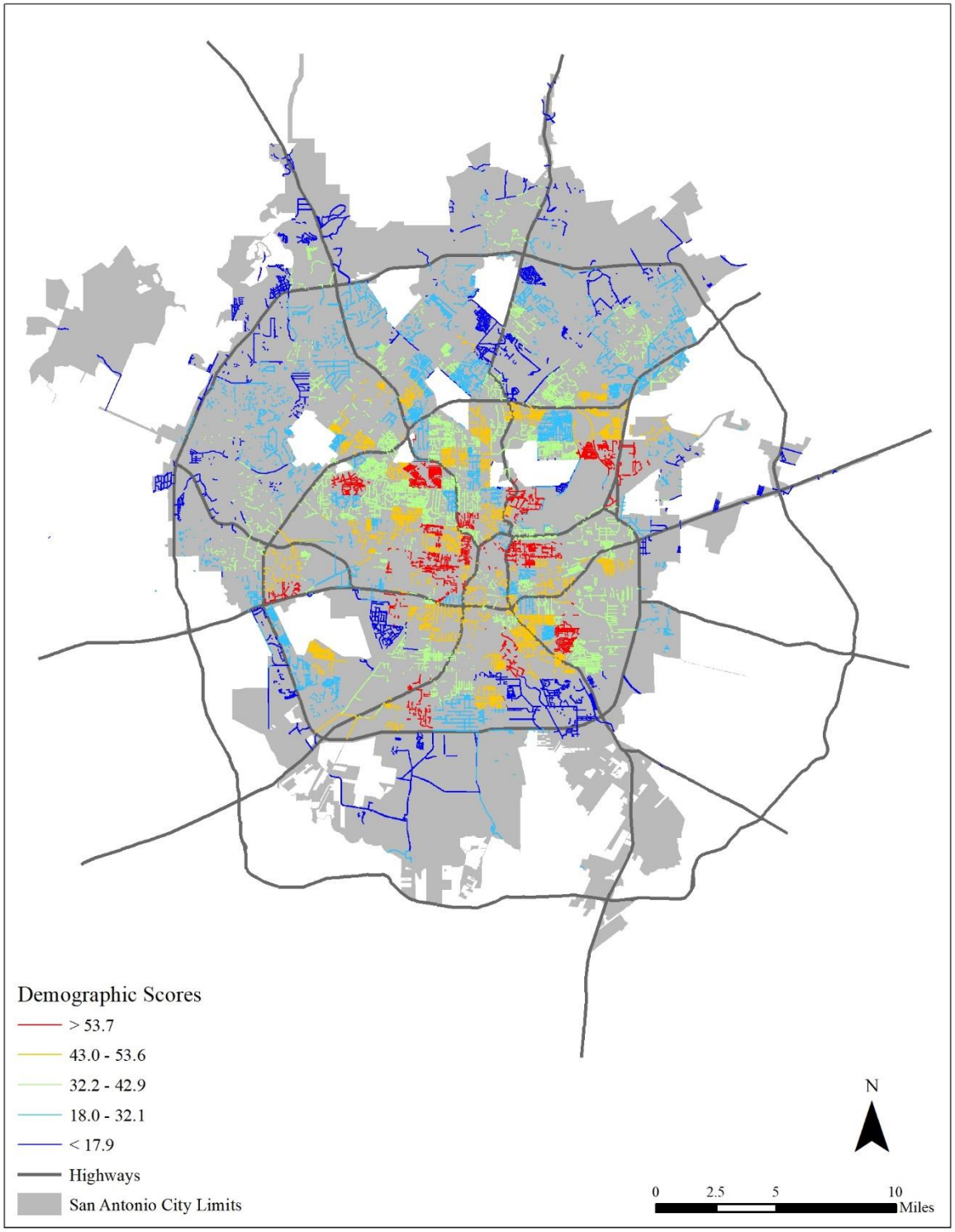


*Figure 8: City of San Antonio Pedestrian Attractor Index Scores*

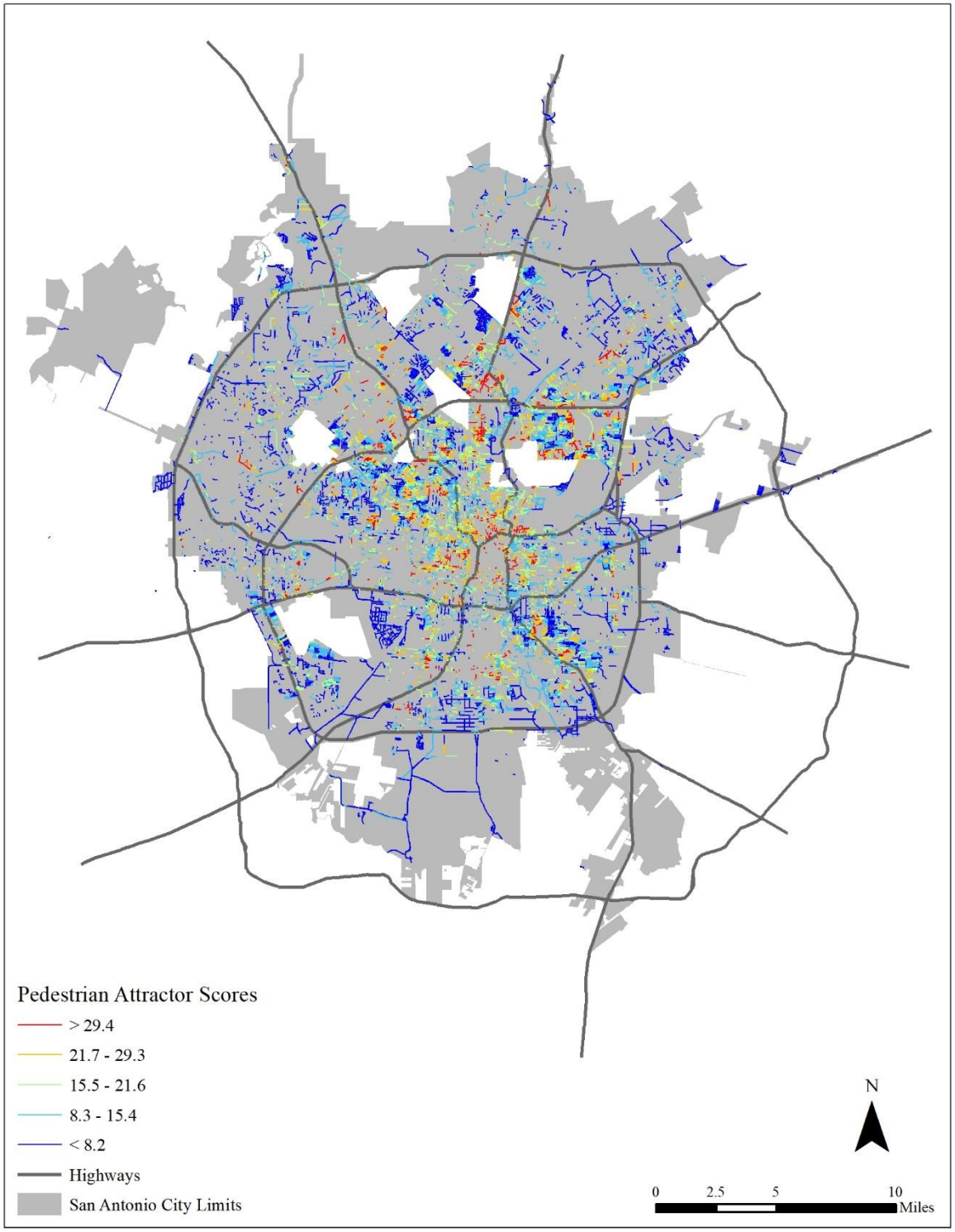


*Figure 9: City of San Antonio Pedestrian Safety / Health Index Scores*

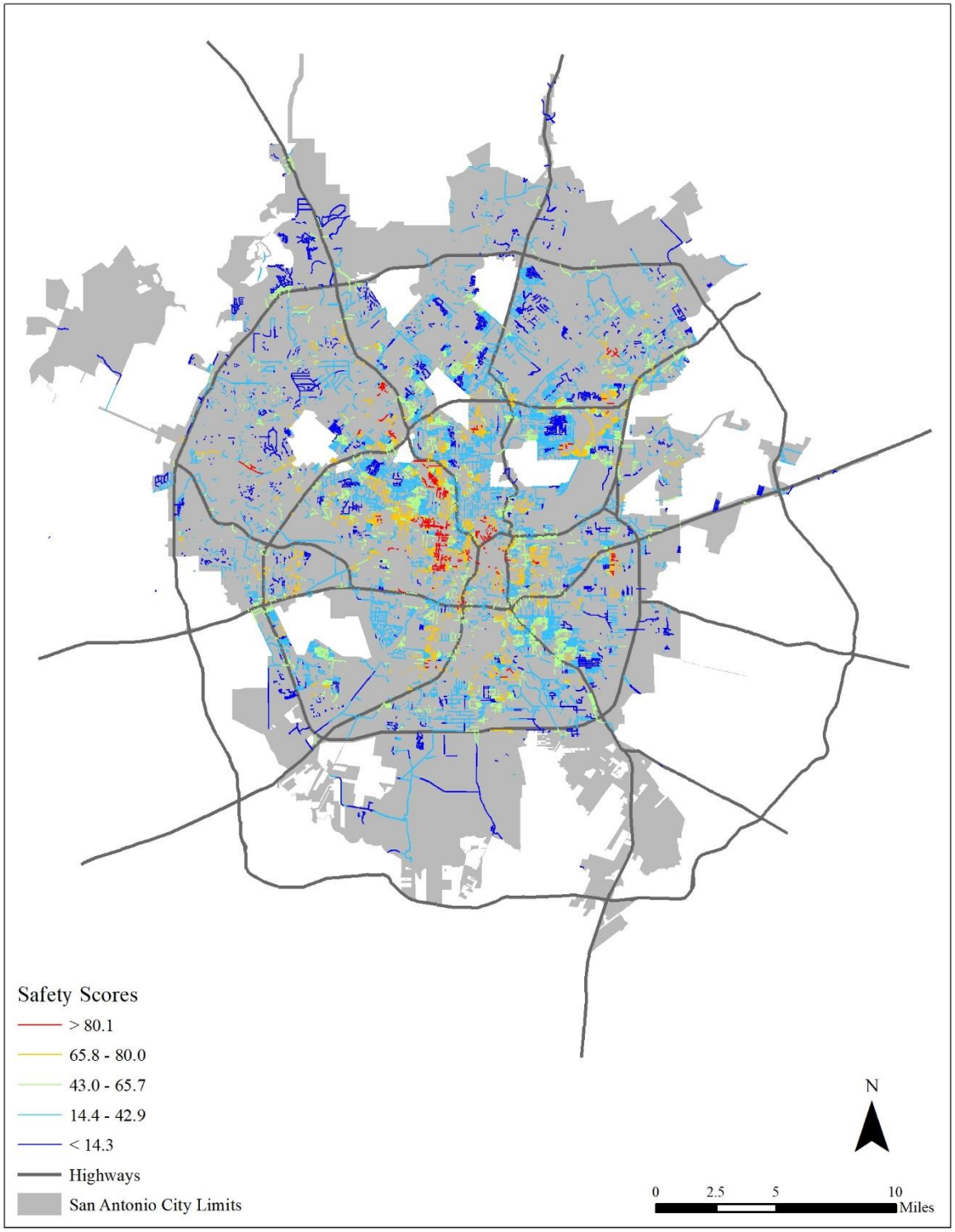
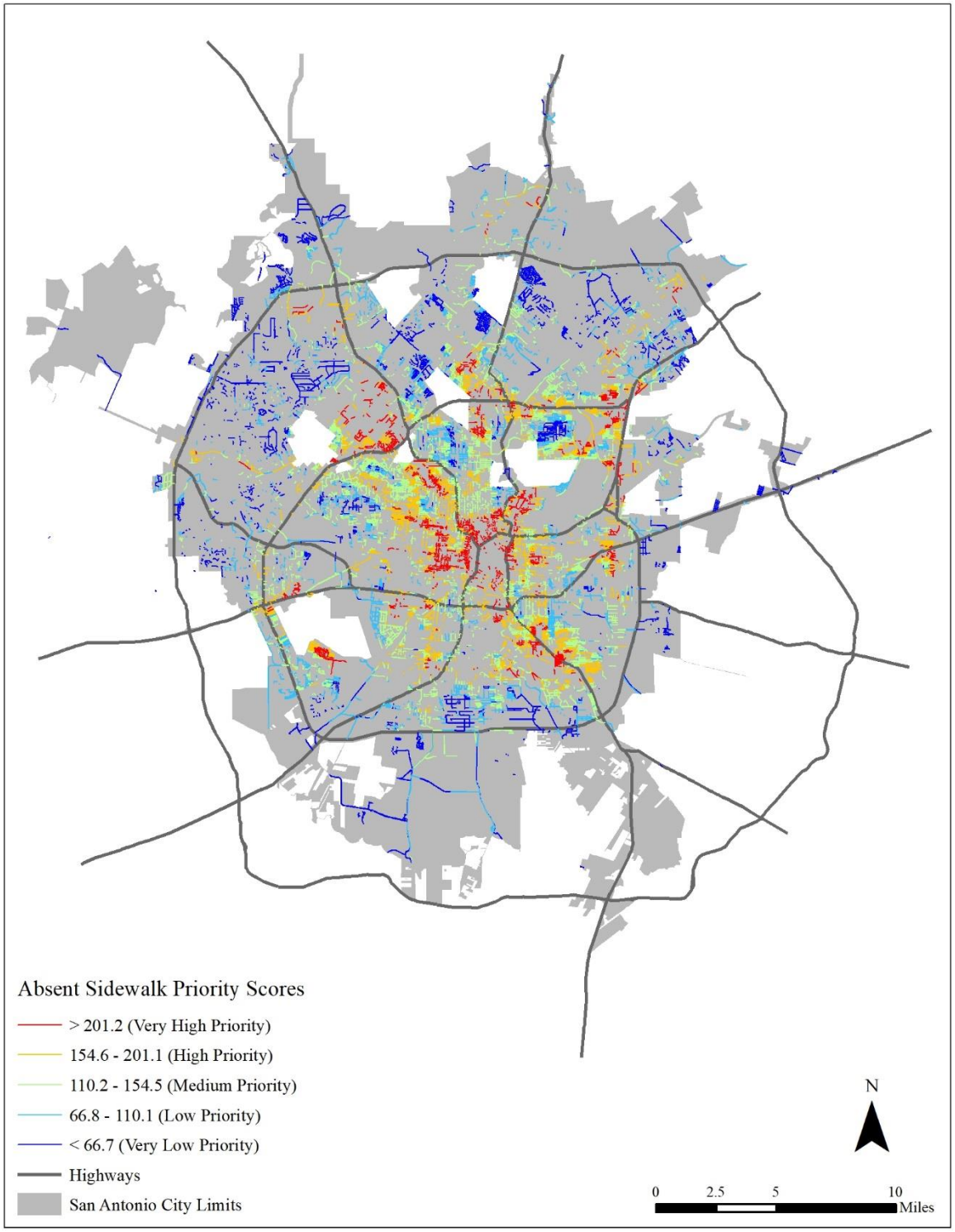


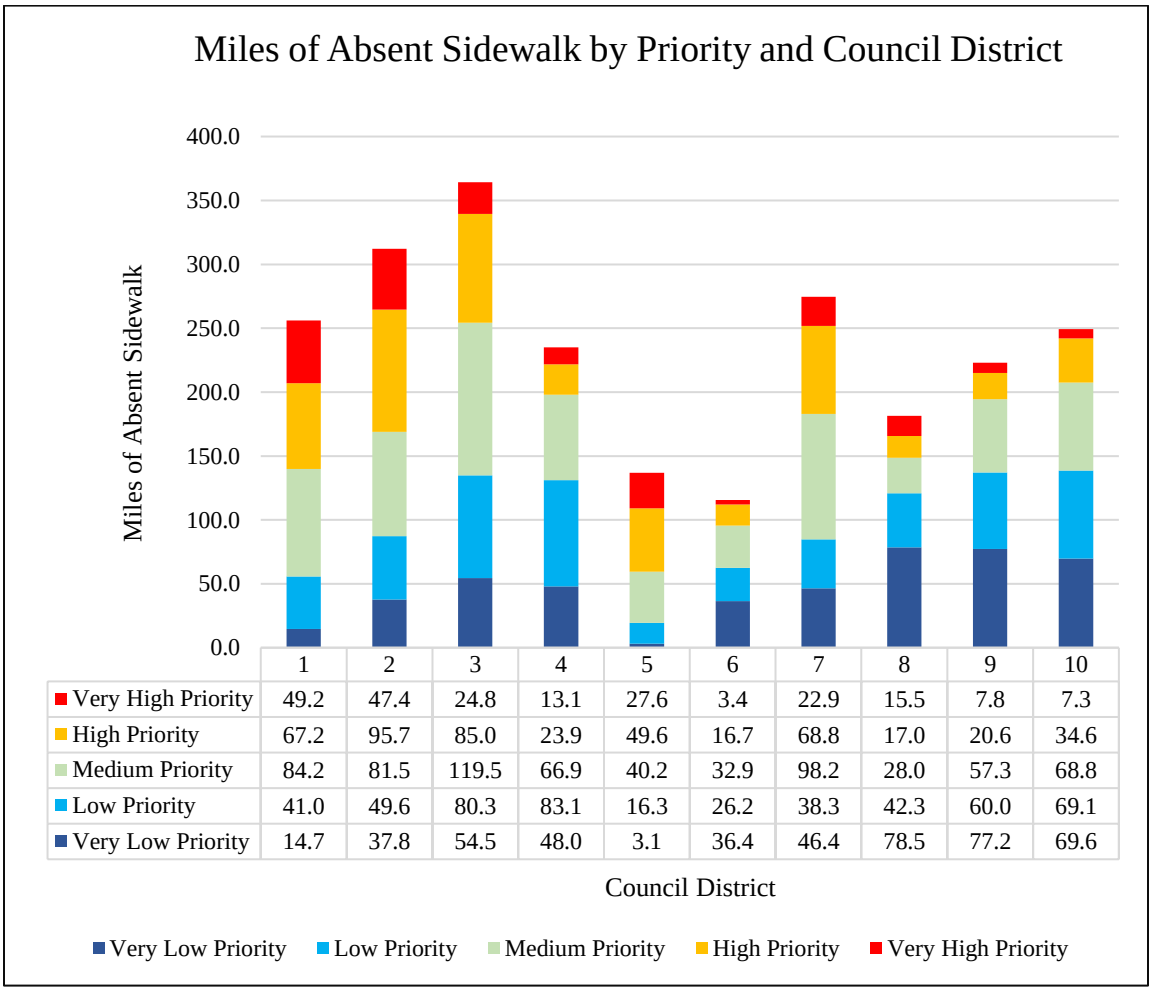
*Figure 10: City of San Antonio Composite Absent Sidewalk Priority Scores*



Evaluating sidewalk priorities has significant ramifications for social equity and the distribution of public dollars. Missing sidewalks in San Antonio have long been recognized as a legacy of historic inequality (O'Hare 2017; Marks 2015) and it has been argued by some members of council that the distribution of sidewalk dollars should account for historic inequalities (Dimmick 2018). San Antonio's absent sidewalk priorities, as determined by this study, are not evenly distributed across the city. Figure 11 shows the breakdown of absent sidewalks by type and council district. Figure 12 highlights the number of miles of high and very high absent sidewalks in each council district. With ten council districts in San Antonio and 698 miles of "High Priority" and "Very High Priority" absent sidewalks (about 30% of all missing sidewalks are classified as either "High Priority" or "Very High Priority"), any council district with over 69.8 miles of missing sidewalks should receive a proportionally greater share of sidewalk funding. The results of this analysis demonstrate there are disproportionate sidewalk needs in council districts 1, 2, 3, and 7, though the construction of all "High Priority" and "Very High Priority" sidewalks benefit residents across the city due to the inclusion of employers and citywide destinations. Greater detail of all absent sidewalks and their prioritization council districts can be seen in Appendix E.

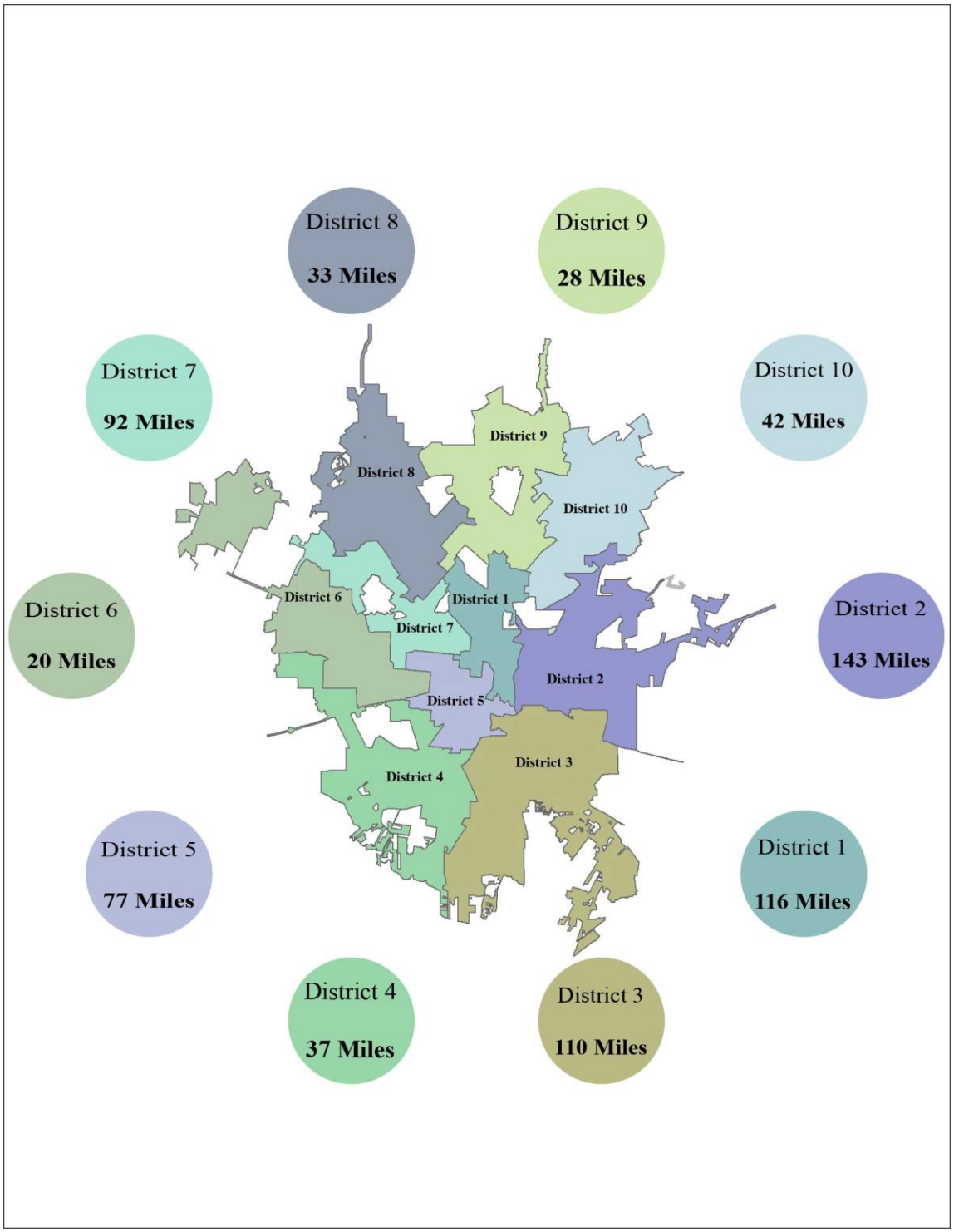
In the absence of data showing uneven needs, a city might be inclined to distribute sidewalk dollars evenly across council districts or to distribute according to a relative share of *all* missing sidewalks. Either of these approaches would delay the construction of higher priority sidewalk needs in districts with a greater share of "High Priority" and "Very High Priority" absent sidewalks.

*Figure 11: Miles of Absent Sidewalk by Priority and Council District*




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Very High Priority | 49.2 | 47.4 | 24.8 | 13.1 | 27.6 | 3.4 | 22.9 | 15.5 | 7.8 | 7.3 |
| High Priority | 67.2 | 95.7 | 85.0 | 23.9 | 49.6 | 16.7 | 68.8 | 17.0 | 20.6 | 34.6 |
| Medium Priority | 84.2 | 81.5 | 119.5 | 66.9 | 40.2 | 32.9 | 98.2 | 28.0 | 57.3 | 68.8 |
| Low Priority | 41.0 | 49.6 | 80.3 | 83.1 | 16.3 | 26.2 | 38.3 | 42.3 | 60.0 | 69.1 |
| Very Low Priority | 14.7 | 37.8 | 54.5 | 48.0 | 3.1 | 36.4 | 46.4 | 78.5 | 77.2 | 69.6 |

*Figure 12: Miles of High and Very High Priority Sidewalks by Council District*



## Future Opportunities for the Absent Sidewalk Prioritization Model

The Absent Sidewalk Prioritization Model that resulted from this study is a more sophisticated method for prioritizing absent sidewalk construction than the current method used by the City of San Antonio which relies primarily on proximity of absent sidewalks to schools and hospitals, and in an unknown way to traffic safety. But, there are opportunities for further refinement. The model is intended to be organic and to be refined over time as data availability and quality increases.

### *Data Quality*

The limitations posed by the quality of existing data is the first opportunity for refining the Absent Sidewalk Prioritization Model. There are limitations to the overall quality of the absent sidewalk priority scores embedded within the data and shapefiles maintained by the City of San Antonio. The lack of maintenance to GIS shapefiles undermines the accuracy and legitimacy of all planning efforts. It is unfeasible for most cities to update and maintain a vast number of datasets. But, cities should aspire to identify those datasets which are critical to its operations. The criteria within the Absent Sidewalk Prioritization Model should be considered among those critical datasets that need updating and maintaining.

### *Policy Index*

Policy priorities other than the comprehensive plan might be considered for the model. The focus group assembled for this study was opposed to including additional policy priorities. But, a larger sample of the public may reach a different conclusion. San

Antonio possesses a number of area-based policy priorities that could be incorporated easily into the model, such as Tax Increment Reinvestment Zones (TIRZ).

*Demographic Index*

The Demographic index criteria used for the model relied upon American Community Survey data expressed in absolute numbers and as rates. Future versions of the model should be consistent in the use of absolute numbers or rates.

The frequency for updating absent sidewalk priority scores should be determined. At a minimum, the tool should be updated when the 2020 Decennial Census data becomes available and should be performed consistently every decade to take advantage of full population data. The Absent Sidewalk Prioritization Model should also be used at a minimum of once in between decennial censuses to account for demographic, safety, and economic shifts throughout the city.

*Pedestrian Attractors Index*

Many of the criteria used within the Pedestrian Attractors index relied upon single GIS shapefiles either provided by a government agency or extracted from Business Analyst using various North American Industry Classification System codes. However, other criteria had to be assembled using various data. Future absent sidewalk prioritization would be much simpler if City of San Antonio created and maintained GIS shapefiles that reflected the full extent of the criteria.

The "schools" criterion had to be created using the San Antonio schools shapefile. However, since it only consists of elementary, junior high, and high schools that are public

schools, data from Business Analyst was needed to capture charter and private schools, community colleges, colleges, and universities. The "spectator venues" criterion was also created using a combination of data from the City of San Antonio "public assembly" shapefile and Business Analyst data due to the fact that the shapefile maintained by the city was missing an extensive number of venues throughout the city. The "government" criterion was similarly created from both San Antonio shapefiles and Business Analyst data.

*Pedestrian Safety / Health*

The Pedestrian Safety / Health index has potential to be enhanced to account for additional safety and health factors. Obesity data was not included in the Absent Sidewalk Prioritization Model because no response was provided to my request for data. Obesity rates should be included in future models. Other criteria could be considered for inclusion, such as asthma rates and violent crime rates.

*Other Criteria*

The focus group identified more criteria for the Absent Sidewalk Prioritization Model than was able to be incorporated into the final model. In most cases, this was due to the necessary datasets being unavailable or non-existent. A GIS shapefile showing the locations of existing curb ramps that are in compliance with the Americans with Disabilities Act (ADA) would improve cost estimations for sidewalk construction. Any absent sidewalk without ADA-compliant curb ramp would need to include those costs in the scoping of the project.

Including the presence of a sidewalk on one-side of the street is another opportunity for the model. Prioritizing the construction of sidewalks where no sidewalk exists on either side of the street is currently not possible because existing sidewalks may possess ADA non-compliant curb ramps or no curb ramps at all. For future models to consider the presence of a sidewalk on one-side of the street, the locations of ADA-compliant curb ramps must be known. Where curb ramps do not exist or exist curb ramps are not ADA-compliant, the presence of a sidewalk on one side of the street must not affect the absent sidewalk score.

Future models could incorporate a gap analysis criterion. A gap analysis would score absent sidewalk segments according to the length of continuous sidewalk network that would be provided if a missing sidewalk was constructed.

Finally, the Absent Sidewalk Prioritization Model prioritizes missing sidewalks irrespective of the costs of constructing individual segments. The intention was to identify those sidewalks most urgently needed. But, because sidewalk funds are a limiting factor and because construction costs are quite variable according to factors such as topography, existing right of way, tree roots, and the need for curbs and drainage, it may be desirable to incorporate projected costs for individual sidewalks. Considering individual segment cost into the prioritization model affords the opportunity to identify those "High Priority" and "Very High Priority" sidewalks that are the cheapest to build, thus enabling more miles of absent sidewalk to be constructed in the near-term. Additionally, the most expensive "High Priority" and "Very High Priority" absent sidewalks may be sites appropriate for the use of alternatives to conventional sidewalks.

In order to consider individual sidewalk costs, San Antonio must develop a method to evaluate the context and site conditions of missing sidewalks. Austin, Texas uses a four-pronged method of evaluation, displayed in Table 6. The designations evaluate for factors that increase the cost of sidewalk construction, such as the need for additional planning, engineering, or curbs. A mobile application was developed to enable data entry in the field.

*Table 6: City of Austin Field Designations for Absent Sidewalks*

| Domain Values | Limited | Moderate | Significant | Extreme |
|---|---|---|---|---|
| **Utility Adjust / Relocate** | None | Few water meters | Some 3rd party utility work may be required | Extensive 3rd party utility work may be required |
| **Traffic Control** | Minimal | Standard | Site specific traffic control plans | |
| **ROW** | No conflicts | Minor curb bumpouts | Consultation / coordination with Transportation required | Significant curb realignment or restriping required |
| **Asphalt** | None | | Extensive | |
| **Handrail** | None | Limited | Significant | |
| **Retaining** | 6" max | 24" max | 48" max | > 4' |
| **Cut / Fill** | 12" max | 24" max | 48" max | > 4' |
| **Irrigation** | None | Limited | Extensive | |
| **Trees** | No conflicts | Limited | Significant | |

*Table 6: City of Austin Field Designations for Absent Sidewalks (continued)*

| | | | | |
|---|---|---|---|---|
| **Notes** | No utility conflicts, minimal engineering oversight required | Typical field engineering projects | Challenging field engineering projects; may require plans or details for specific areas | Not appropriate for field engineering without preliminary plans, studies, utility coordination, etc. to address constraints; may not be appropriate for Sidewalk IDIQ contracting |

Source: City of Austin Sidewalk Program

# CHAPTER 5: FUNDING STRATEGIES AND ALTERNATIVES TO SIDEWALKS

Completing and maintaining San Antonio's sidewalk network will require substantial capital dollars. It is imperative that San Antonio identify strategies to pay for the $1.21 billion in new sidewalk construction and the $24-$36 million in annual sidewalk maintenance.

There are multiple ways a city can fund new sidewalks. The various funding mechanisms for new sidewalk construction are listed in Table 7. San Antonio uses some of these, including general revenue dollars, bonds, and dedicated sales taxes. Periodically, San Antonio provides money for new sidewalks through its annual budget. This was the case in the fiscal year 2018 budget when the City Council provided $5 million for sidewalk construction to supplement the $78 million in sidewalk projects approved through the 2017-2022 bond referendum (Dimmick 2018).

San Antonio also has a special district which provides sidewalk construction dollars. The Advanced Transportation District is a voter-approved quarter-cent sales tax increase, 25% of which is dedicated for sidewalk maintenance and construction (MWM Design Group and City of Austin 2015).

*Table 7: Recommended Funding Sources for New Sidewalks*[17]

| Funding Source | Description | Notes | Used by San Antonio |
|---|---|---|---|
| **Bonds** | Voter approved debt paid back through property taxes. | Allows citizens to determine appropriate level of funding to meet new sidewalk construction goals. | Yes |
| **Grants** | Grants available through the Alamo Area Metropolitan Planning Organization (AAMPO). | Typically requires local matching funds. | Yes |
| **Enforcement Fees** | Fees resulting from pedestrian or sidewalk related violations. | Dedicate a share of ticket fees received for things such as speeding and parking tickets. | Unknown |
| **New Development Sidewalk Impact Fee** | Fees assessed to new development to provide offsite pedestrian infrastructure. | Impact Fees subject to requirements and limitations of Chapter 395 of Texas Local Government Code (Prohibits use of impact fees for repair or maintenance of existing infrastructure). | No |
| **Commercial Driveway Assessment** | Assess commercial property owners to pay for driveway repairs required to provide for ADA compliant sidewalk construction. | Approximately 19% of the cost of sidewalk projects is associated with driveways; this percentage can be higher on commercial corridors.<br><br>Assessment would provide incentive to reduce driveway widths thereby reducing pedestrian/auto conflict areas. | No |
| **Special District** | Allows for portion of funds from parking meters or dedicated sales tax to be used for infrastructure improvements. | San Antonio's Advanced Transportation District is a voter-approved 1/4 cent sales tax, 25% of which is dedicated to new sidewalk construction and maintenance. | Yes |

[17] The information contained in this table was adapted from City of Austin's *Sidewalk Master Plan*.

Funding opportunities exist of which San Antonio is not currently taking advantage. Foremost among these is developing and implementing a commercial driveway assessment. A commercial driveway assessment would bill the property owner for the costs of bringing the driveway into compliance with the Americans with Disabilities Act when new sidewalks are installed. Discounted rates could be offered for property owners willing to reduce the driveway width or consolidate driveways with adjacent businesses, thus providing additional pedestrian safety benefits particularly along corridors with numerous driveways. A commercial driveway assessment was recommended within Austin's Sidewalk Master Plan / ADA Transition Plan (City of Austin et al. 2016).

Recent attention has been paid in San Antonio to the "secondary costs" associated with sidewalk construction, such as right of way management costs during construction, landscaping costs to restore residential property damaged during construction, and driveway construction costs (Dimmick 2018). Table 8 shows the results of a recent auditor's report finding that only 30% of sidewalk dollars go toward actual sidewalk construction and 19% go toward constructing ADA-compliant driveways (City of San Antonio Office of the City Auditor 2018).

Council Member Treviño, an architect, has made it a policy priority to achieve greater sidewalk construction by finding ways to construct sidewalks more cheaply through the use of precast concrete (Serna 2015), and by making the construction of sidewalks more cost-efficient; in fact, he wants to double the miles of sidewalks constructed with the same amount of money (Serna 2018). However, the "secondary costs" associated with sidewalk construction targeted by Council Member Treviño are directly related to building ADA-

compliant sidewalks, and city staff notes that constructing sidewalks sometimes requires tearing up lawns or driveways, or re-locating water and electric lines (Conger 2018). Reducing overall public expenditures through sidewalk construction is a laudable goal. But, San Antonio should be careful to avoid eroding the quality of a program viewed favorably by the public by forcing efforts to reduce costs.

*Table 8: Sidewalk Construction Costs Breakdown, Fiscal Years 2016-2017*

| Category | Cost | % |
|---|---|---|
| Concrete Sidewalks | $5,680,430 | 30% |
| Concrete Driveway | $3,528,031 | 19% |
| Concrete Curb | $3,231,777 | 17% |
| Removal of Existing | $2,012,112 | 11% |
| Street | $1,341,536 | 7% |
| Landscaping | $1,382,503 | 7% |
| Retaining Walls, Steps, Railing | $736,312 | 4% |
| Signage and Pavement Markings | $399,283 | 2% |
| Safety | $320,884 | 2% |
| San Antonio Water System (SAWS) | $177,336 | 1% |
| Fencing | $59,282 | 0% |
| **Total** | **$18,869,486** | **100%** |

There are several opportunities to reduce the overall costs of completing a sidewalk network by finding alternatives to traditional sidewalk construction. First, the use of cheaper materials, such as precast concrete championed by Council Member Treviño, have advantages over sidewalks poured on-site. In particular, precast concrete can be more resilient to poor soils that can crack concrete poured on-site (Serna 2015).

The City of Seattle makes use of a second technique to reduce overall sidewalk construction costs. Seattle is taking advantage of existing street pavement to create "protected walking lanes," as seen in Figure 13, rather than building traditional sidewalks within the right of way. These systems have the potential advantage of being used where traditional sidewalks have been cost-prohibitive, such as where additional right of way space is needed, or where drainage ditches exist along roadways. They are additionally beneficial because of the possibility of rapid installation and because they are much less expensive. The example below from Seattle is reported to cost only $26,000 versus $300,000 for a conventional sidewalk (Schmitt 2018).

*Figure 13: Protected Walking Lane*

Credit: Dongho Chang

Despite the significant cost savings of "protected walking lanes" or similar treatments that make use of existing street space, cities should be careful to avoid installing an infrastructure that provides less comfort or that is perceived to be less safe than conventional sidewalks. The risk is installing an infrastructure that is regarded as inferior and that fails to encourage walking. At present, too little research exists as to how these facilities are perceived. Alternatives to sidewalks should be employed as pilot programs and evaluated for their performance before implemented citywide.

Third, implementing shared streets is another option to take advantage of existing infrastructure and right of way. Unlike a typical street where modes of traffic are segregated from one another, a shared street is one in which different modes of traffic share the same space with slower moving traffic receiving the right of way. Popular in Amsterdam, *woonerfs* (a Dutch term for shared street) encourage mixing of traffic by eliminating the curb and segregated space. As shown in Figure 14, *woonerfs* use various urban design techniques such as the use of different materials, trees, and pedestrian spaces, to encourage the intended use and function.

Shared streets are now constructed or planned for 400 cities across the United States (Midtown Community Works 2017), including: Bell Street Park, South Lake Union, and 45th Avenue South in Seattle; Wall Street in Asheville, North Carolina; Palmer & Winthrop Street in Cambridge, Massachusetts; Cady's Alley and The Wharf in Washington, D.C.; West 29th Street and Mill City Quarter adjacent to 2nd Street in Minneapolis; and Argyle Street in Chicago. Austin, Texas incorporated shared streets into its Sidewalk Master Plan specifically as an alternative to sidewalk construction (City of Austin 2016) and the

National Association of City Transportation Officials (NACTO) has developed design guidelines for commercial and residential shared streets (NACTO 2013).

*Figure 14:* A *Woonerf*

Credit: https://www.livingstreetsalliance.org/resources/useful-terms/

Shared streets may not have the same cost-saving advantages, however. The elevated urban design elements required to implement a successful shred street comes with a cost that can rival conventional sidewalk construction. The advantage lies in a superior public project and potential safety improvements, as well as the potential cost-sharing that can occur between multiple departments such as Planning, Parks, Sustainability, and Transportation and Capital Improvements.

# CHAPTER 6: CONCLUSIONS

Sidewalks are vital public infrastructure to achieve numerous social goals such as increasing walking rates, decreasing vehicle miles traveled, air pollution, and traffic safety, and achieving compliance with the federal Americans with Disabilities Act. However, decades of failing to require sidewalk construction with new development has left San Antonio with 2,484 miles of absent sidewalk needing to be built at a cost of $1.21 billion over 222 years. Further, San Antonio will eventually require $36 million annually to maintain a complete sidewalk network. At present, San Antonio is failing to adequately fund new sidewalk construction and the maintenance of existing sidewalks.

Currently, San Antonio prioritizes new sidewalk construction according to a relatively simple method using primarily two factors: proximity to schools and hospitals. This study proposes a method to prioritize absent sidewalk construction using a more sophisticated scoring system, one with more criteria that reflects the multiple dimensions of pedestrian needs.

Multiple decision-making tools exist to assist in this aim. A Weighted Sum Model (WSM) was chosen due to multiple inherent advantages making it ideal for use in San Antonio. WSMs consider non-monetary factors unlike other decision-making tools. WSMs are easy to develop and to implement which is beneficial for a city constrained in capacity, resources, and time. They are also simple to understand which fosters a transparent public process and public trust in a system that may ultimately require public support to approve the requisite capital dollars. And, they can deal with complex problems with many criteria, and don’t require perfect and full data to be reliable. In fact, WSMs are ideal for arriving at interim solutions while also accommodating improvements to data.

Two critical steps for developing a Weighted Sum Model are the development of the set of criteria to be included, and the weighting of the criteria. For that, extensive research was performed of peer cities to understand common prioritization criteria. And, a focus group was used to ensure the prioritization method developed for this study reflects the values of San Antonio residents.

The Absent Sidewalk Prioritization Model developed for this study makes use of extensive data sets from multiple sources. ArcGIS was used to generate scores for each one of over 29,000 absent sidewalk segments for each of 26 selected criteria according to the geospatial proximity. The final absent sidewalk scores produced by the model show a large range of scores across the five-tiered classification. The model successfully shows the "High Priority" and "Very High Priority" absent sidewalks are in greater need. The model has significant implications for the distribution of sidewalk funds and could benefit council districts that have experienced historical inequality in infrastructure expenditures. The practice of distributing sidewalk infrastructure dollars equally harms San Antonio's ability to provide the most needed infrastructure and impairs San Antonio's ability to address numerous mobility, health, and environmental goals.

Concern may be expressed that the development of a formal prioritization tool will eliminate the opportunity for ongoing public participation regarding the allocation of sidewalk construction funds. This author would counter that the Absent Sidewalk Prioritization Tool simply focuses public participation on the most urgently needed sidewalks. The results from the Absent Sidewalk Prioritization model show there are 698 miles of "High" and "Very High Priority" absent sidewalks. At the current pace of sidewalk construction, it will still take San Antonio over 60 years to complete the network of the highest priority sidewalks. Additional public engagement – beyond that which was done through the focus group – should focus on further prioritizing the highest priority missing

sidewalks. The $78 million available through the 2017-2022 bond should also be focused on constructing the highest priority sidewalks identified through this analysis.

The Absent Sidewalk Prioritization model should not be regarded as static. Opportunities for improvement were identified, such as the improvement to the datasets used for the current model and the development of additional datasets that could increase the number of criteria used thereby further increasing the sophistication of the tool. The model should be run at a minimum of every five years to account for shifting demographic, economic, and safety conditions throughout the city. And, it should make use of full population counts through decennial census data. The American Community Survey data used for this study are of high quality, but population sampling can never be as reliable as full population counts.

This study identified alternatives to conventional sidewalks that may be able to reduce the substantial financial requirements to building a sidewalk or pedestrian network. “Protected walking lanes” and shared streets offer the potential to reduce the costs of completing the sidewalk network and increase the opportunities for cost sharing. However, alternatives to sidewalks must be evaluated through pilot programs to ensure the treatments don’t produce less quality infrastructure as measured by pedestrian comfort and walking rates.

San Antonio must act to address its current deficient sidewalk infrastructure. The inadequate funding level and extensive sidewalk needs – both absent sidewalks and the woeful condition of existing sidewalks – make it vulnerable to lawsuit through the Americans with Disabilities Act. It must increase funding and implement the Absent Sidewalk Prioritization Model which identifies the highest priority sidewalks to be built first. Additionally, a condition assessment of San Antonio’s existing sidewalks must be performed. The condition assessment would determine the scope of the maintenance

obligation which exists across the city and would also identify opportunities for bringing a greater share of San Antonio's sidewalks into functional or full compliance with the Americans with Disabilities Act.

# Appendix A: Consent to Participate in Focus Group Research

## Consent to Participate in Focus Group Research

### Identification of Investigator and Purpose of Study

You are invited to participate in a research study, entitled "A Methodology to Prioritize Sidewalk Infrastructure for San Antonio." The study is being conducted by Robert Anderson, Department of Community and Regional Planning of The University of Texas at Austin, School of Architecture, 310 Inner Campus Drive B7500, Austin, TX 78712-1009, (512) 762-4134, or robertnanderson@gmail.com.

The purpose of this research study is to examine data-driven methods to prioritize construction of missing sidewalks that can be applied across the City of San Antonio and which reflects the values of the community through the identification of specific criteria and the weighting of scores. Your participation in the study will contribute to a better understanding of what data to include, and how to weight the included data. You are free to contact the investigator at the above address and phone number to discuss the study. You must be at least 18 years old to participate.

If you agree to participate:

- The **focus group conversation** will take approximately **2 hours** of your time for each focus group session you choose to participate in.
- You will share your thoughts on data to include in absent sidewalk construction, such as traffic crash locations or school locations.
- You will share your thoughts on how the multiple data should be weighted to reflect community values.
- You **will not** be compensated.

### Risks/Benefits/Confidentiality of Data

There are no known risks. There will be no costs for participating, nor will you benefit from participating. No personal identifying information will be collected or asked for during this research. A limited number of research team members will have access to the data throughout the study.

### Participation or Withdrawal

Your participation in this study is voluntary. You may decline to answer any question and you have the right to withdraw from participation at any time. Withdrawal will not affect

your relationship with The University of Texas in any way. If you do not want to participate either simply stop participating or leave the focus group.

If you do not want to receive any more reminders, you may email us at robertnanderson@gmail.com**.**

**Contacts**
If you have any questions about the study or need to update your email address contact the researcher Robert Anderson at (512) 762-4134 or send an email to robertnanderson@gmail.com. This study has been reviewed by The University of Texas at Austin Institutional Review Board and the study number is 2017-06-0067.

**Questions about your rights as a research participant.**
If you have questions about your rights or are dissatisfied at any time with any part of this study, you can contact, anonymously if you wish, the Institutional Review Board by phone at (512) 471-8871 or email at orsc@uts.cc.utexas.edu.

If you agree to participate, please acknowledge that you understand the study and are participating voluntarily.

Thank you.

# Appendix B: Focus Group Discussion Guide

### Discussion Guide for Focus Group

- To begin, could each of you tell me about your experience as a pedestrian. For example, why do you walk? Do you walk for transportation or for recreation? How far do you walk?

- For those that walk for transportation, where do you walk to? What is your destination?

- For those that walk for recreation, where do you choose to walk?

- Are there times you would like to walk but do not? What are the circumstances for wanting to walk (time of day, distance, destination, etc.) and what are the reasons for why you choose not to?

- Currently, the City of San Antonio prioritizes sidewalk construction for segments that are close to schools and hospitals. Are there are other criteria you think should be used for prioritizing absent sidewalk construction?
    - If focus group members don't mention the following, ask about these factors:
        - Age of residents in an area
        - Rate of automobile ownership
        - Income
        - Rates of persons with disabilities
        - Housing density
        - Employment density
        - Destinations such as retail and commercial establishments, restaurants, etc.
        - Cultural amenities
        - Bus routes
        - Street types
        - Pedestrian fatalities or serious injuries
        - Obesity rate
        - Connectivity (continuous presence of sidewalks)
        - Factors that result in unsafe conditions for pedestrians
    - The Mayor and several Councilmembers have placed a lot of emphasis on equity as a factor in the expenditure of bond dollars for sidewalk construction. What do you think should/can be used to measure equity?

[At this point, suggest grouping the criteria into themes. Once that is done, discuss how to weight the categories for scoring]

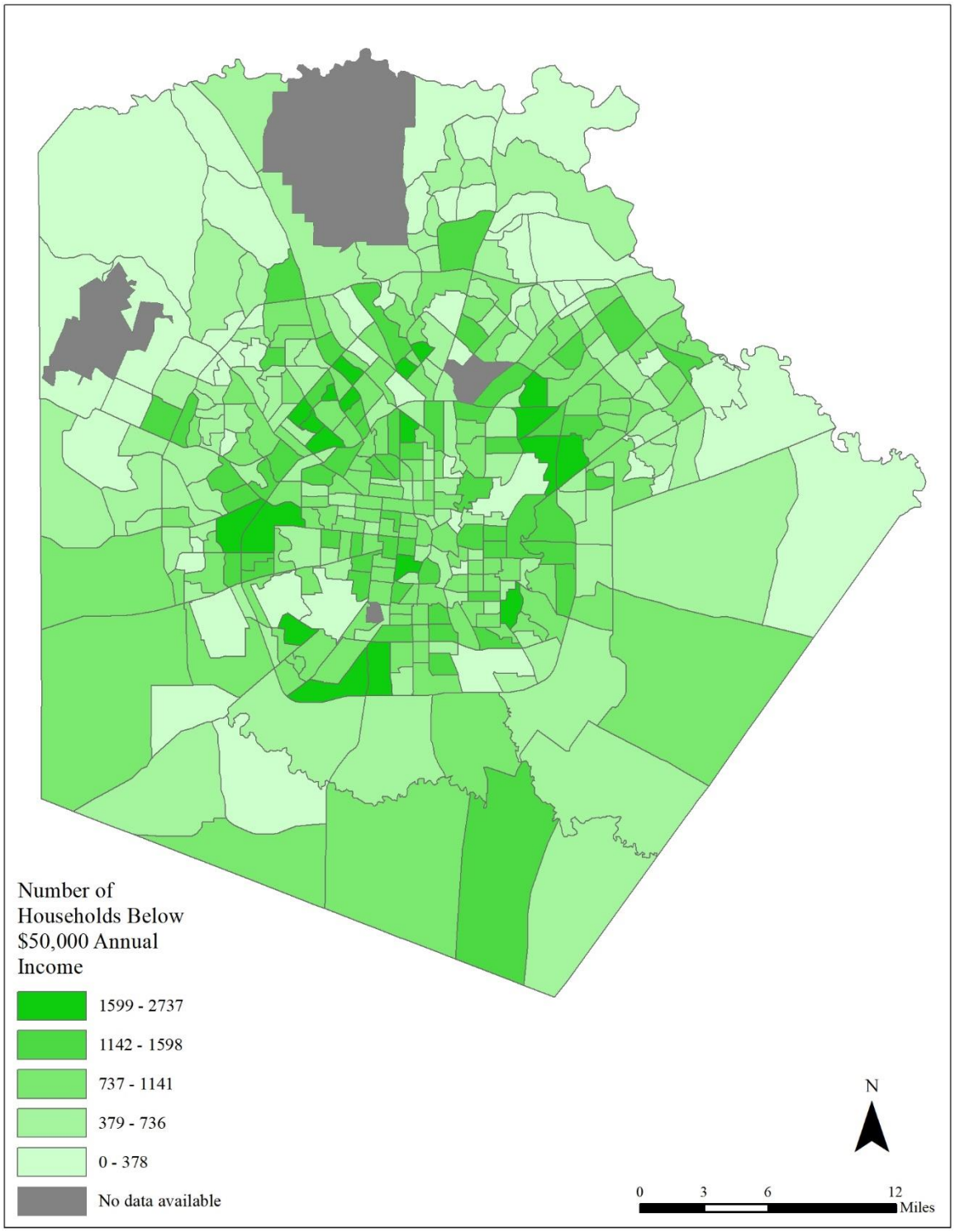
- Overall, what is the most important category? What percentage of the overall score should this category represent?

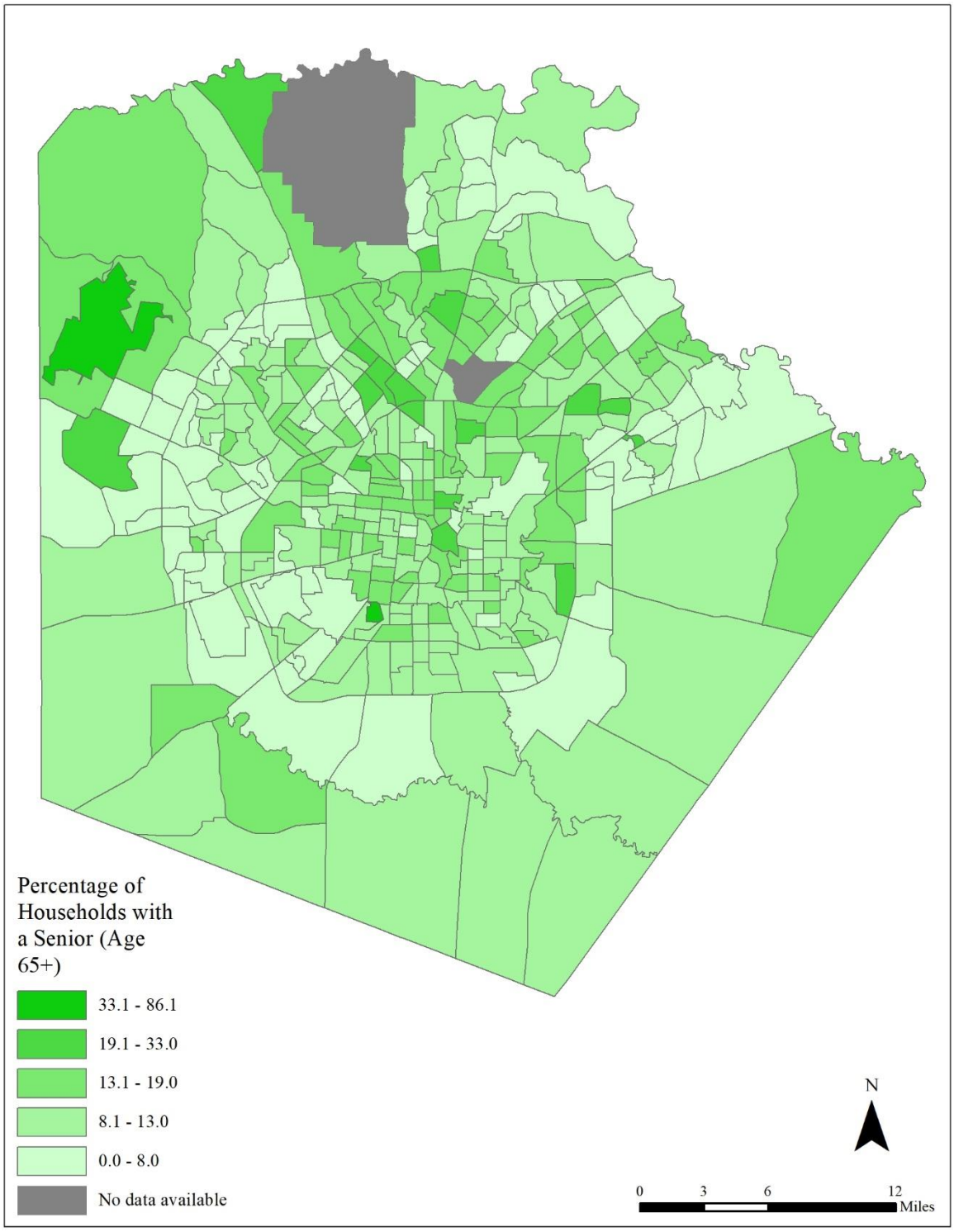
[Repeat for all categories created until each category has an assigned percentage of the overall score]

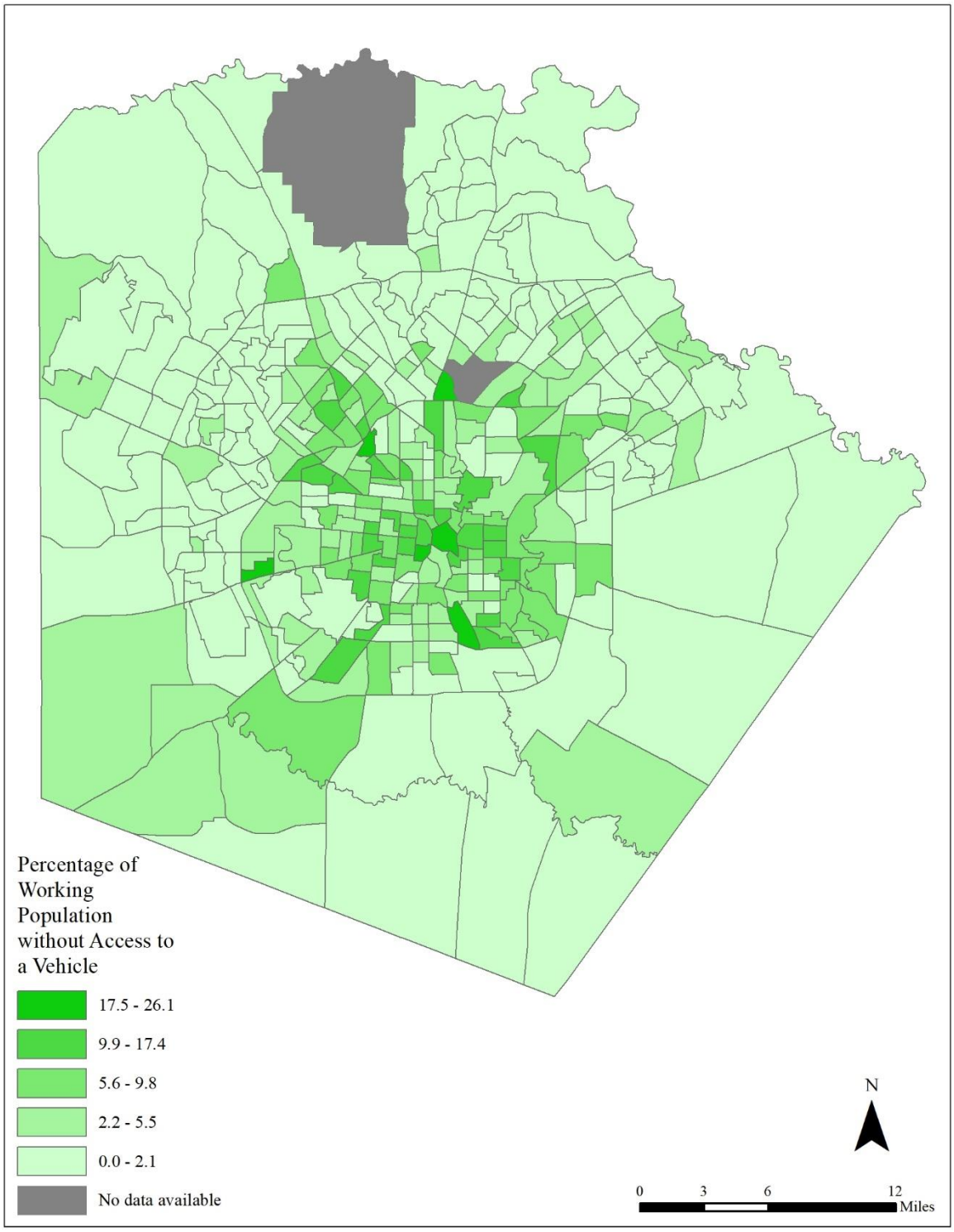
Within the first category, can you identify several of the most important individual criteria? How much of the overall category score should these individual criteria receive?

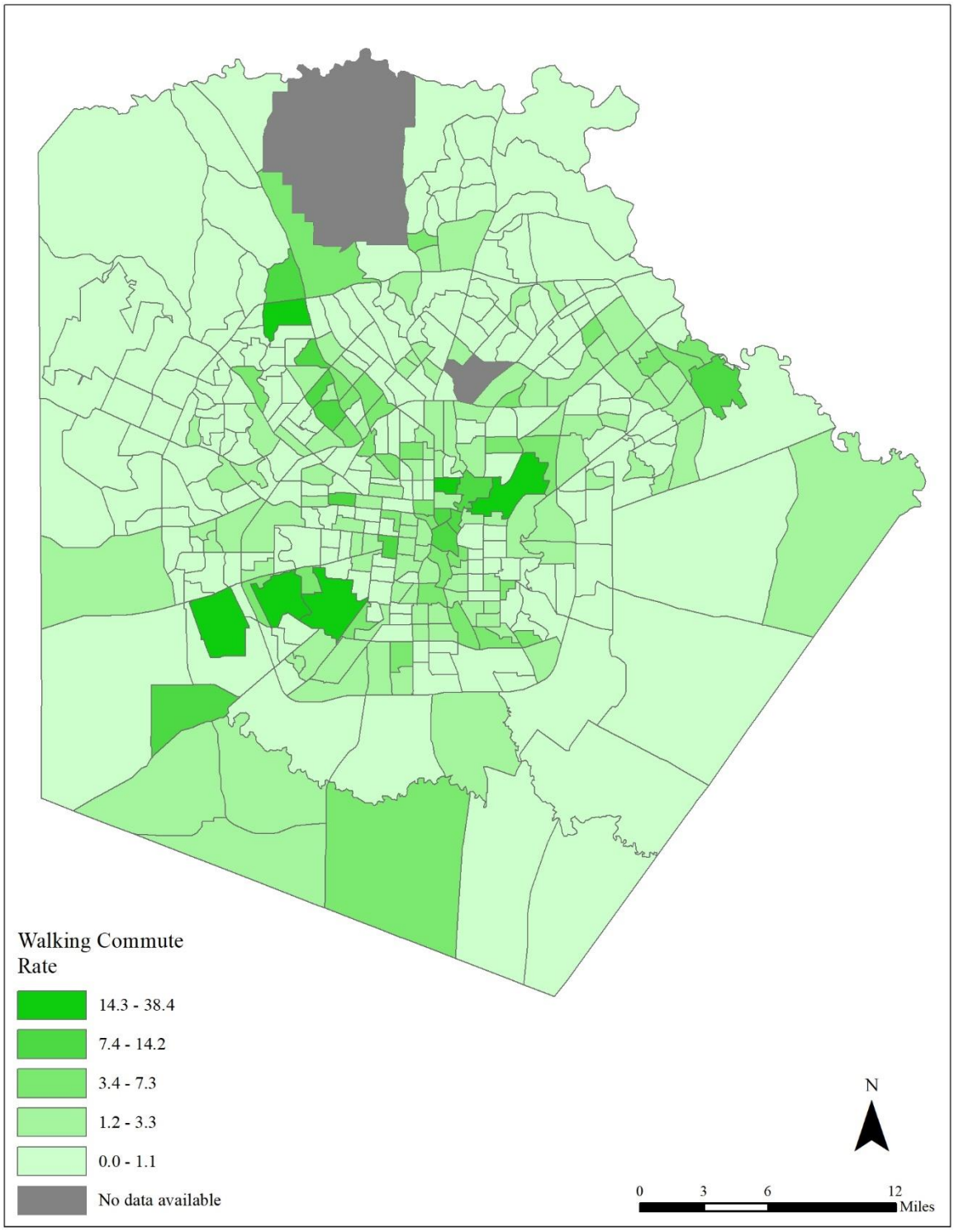
[Repeat for all categories until there is general consensus regarding the relative importance of the absent sidewalk criteria]

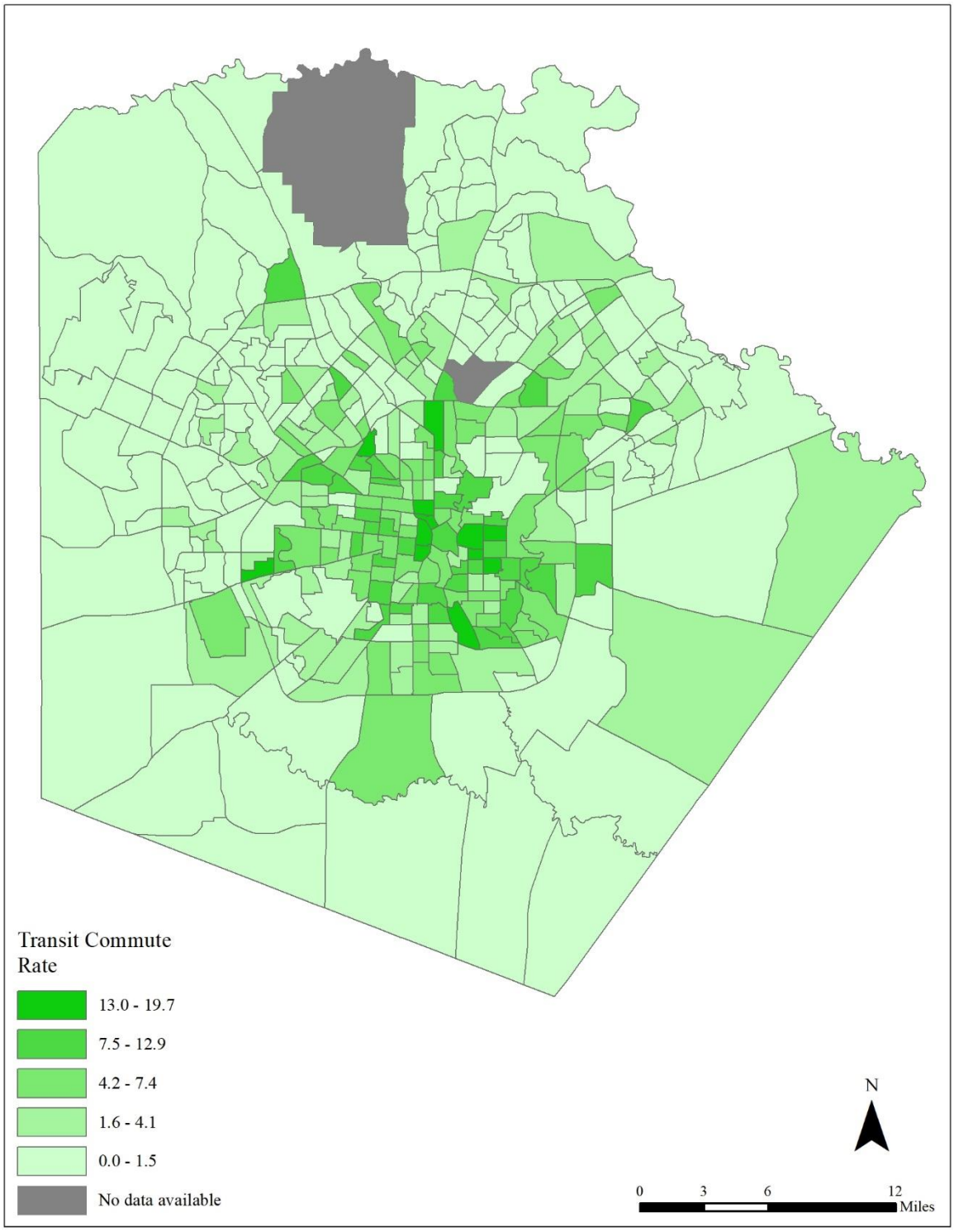
# Appendix C: Unavailable Census Tract Data



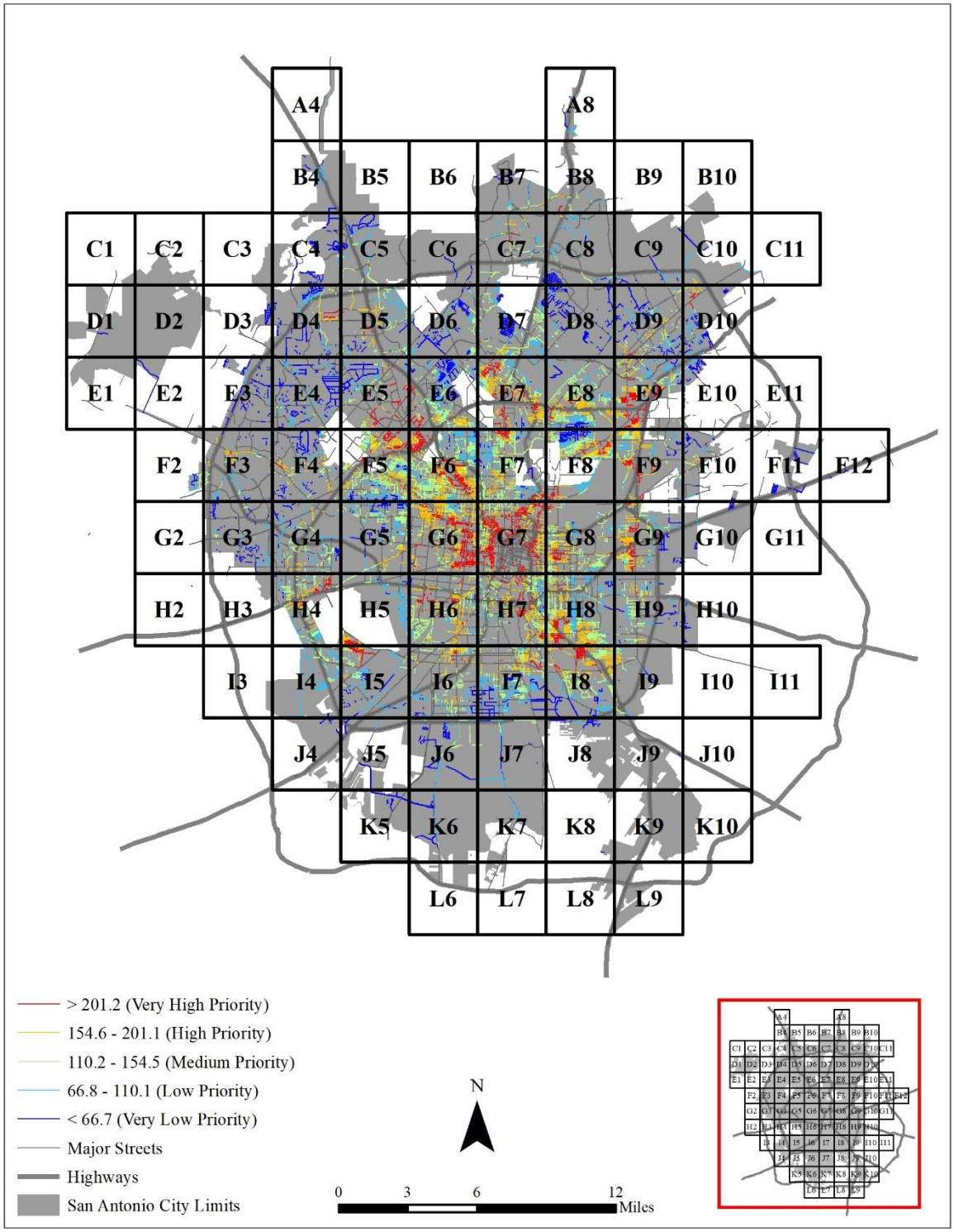

Percentage of Households with a Senior (Age 65+)
33.1 - 86.1
19.1 - 33.0
13.1 - 19.0
8.1 - 13.0
0.0 - 8.0
No data available
N
0
3
6
12
Miles

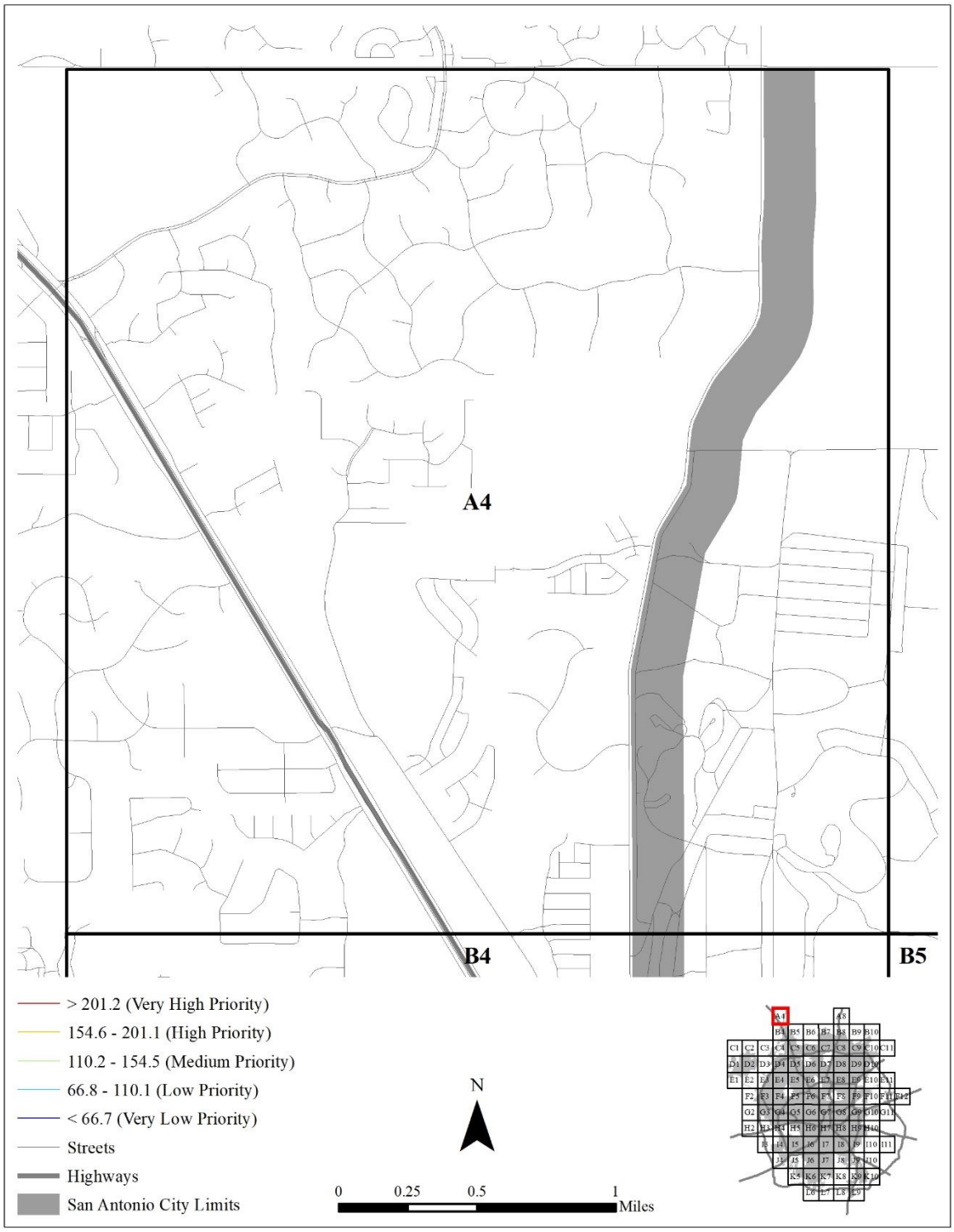

Percentage of Working Population without Access to a Vehicle
17.5 - 26.1
9.9 - 17.4
5.6 - 9.8
2.2 - 5.5
0.0 - 2.1
No data available
N
0
3
6
12
Miles

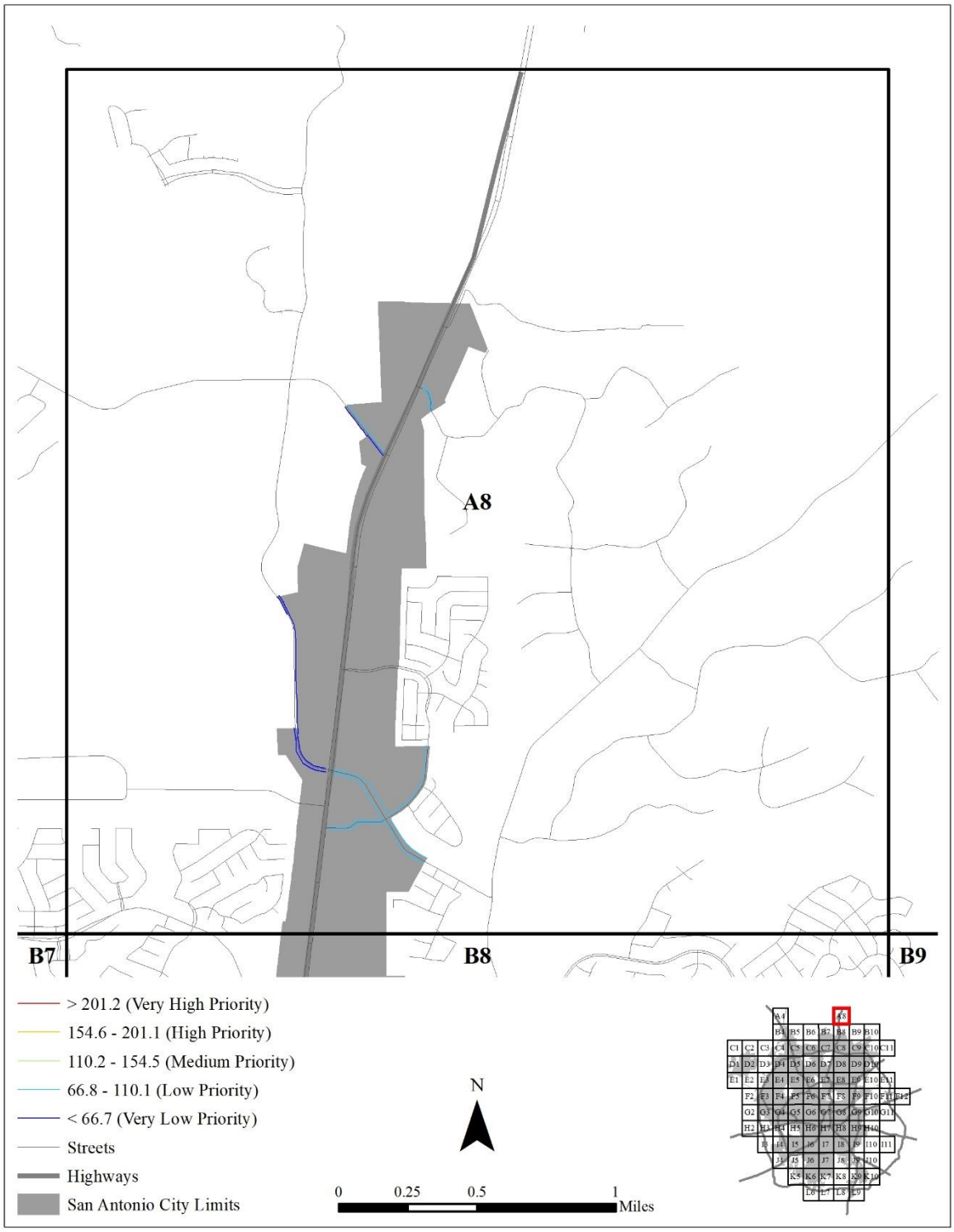

Walking Commute Rate
14.3 - 38.4
7.4 - 14.2
3.4 - 7.3
1.2 - 3.3
0.0 - 1.1
No data available
N
0
3
6
12
Miles

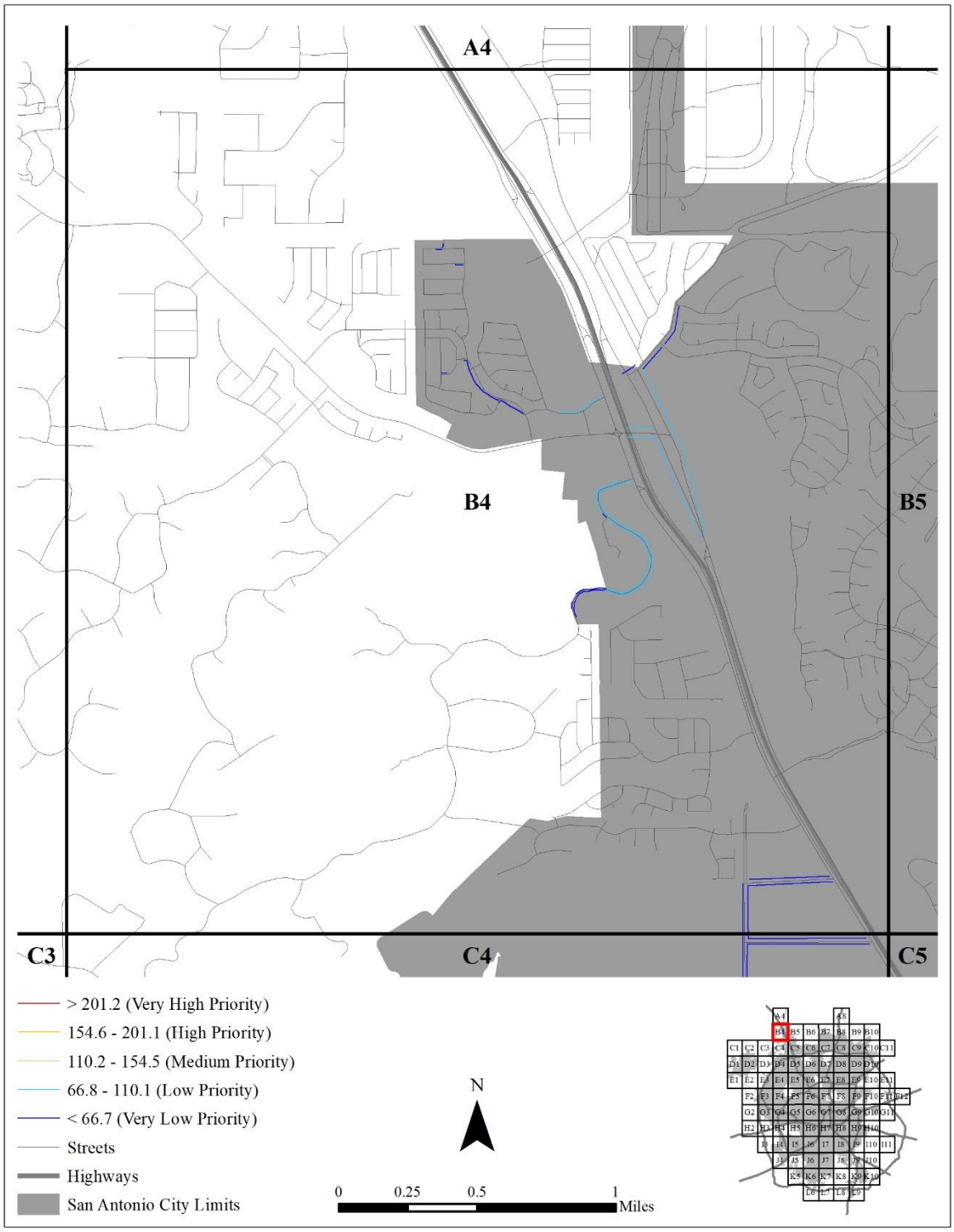

Transit Commute Rate
13.0 - 19.7
7.5 - 12.9
4.2 - 7.4
1.6 - 4.1
0.0 - 1.5
No data available
N
0
3
6
12
Miles

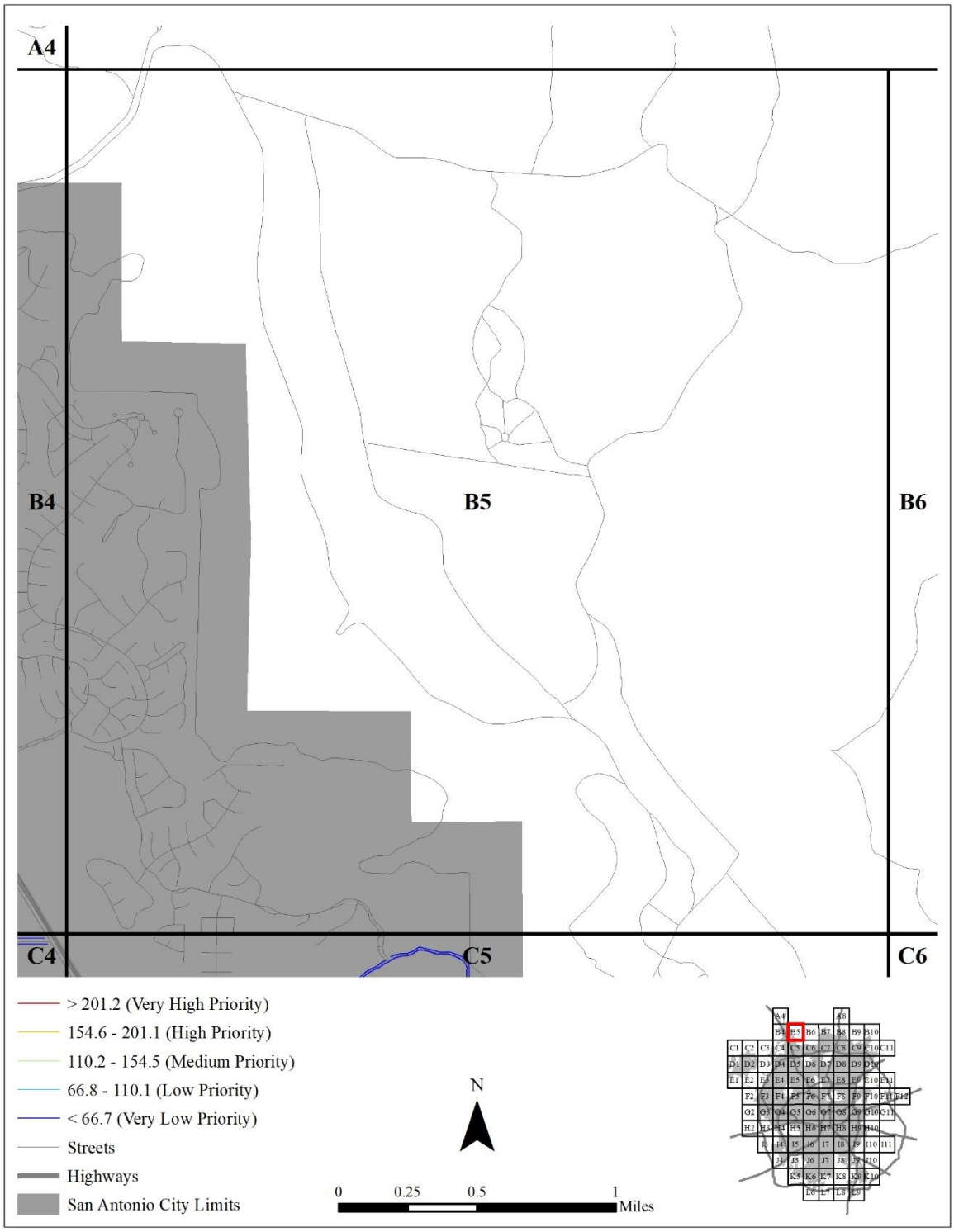
# Appendix D: Absent Sidewalk Map Series

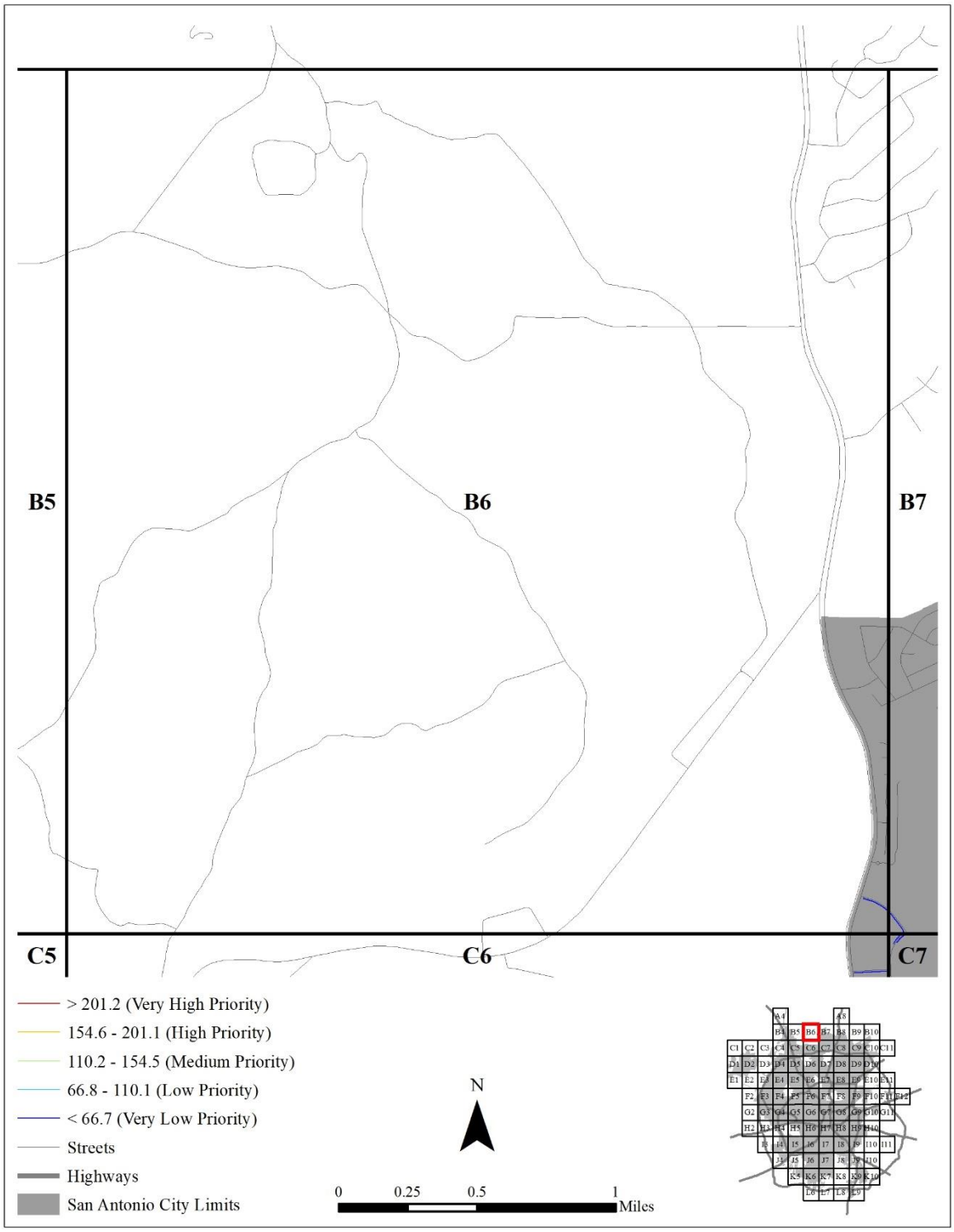


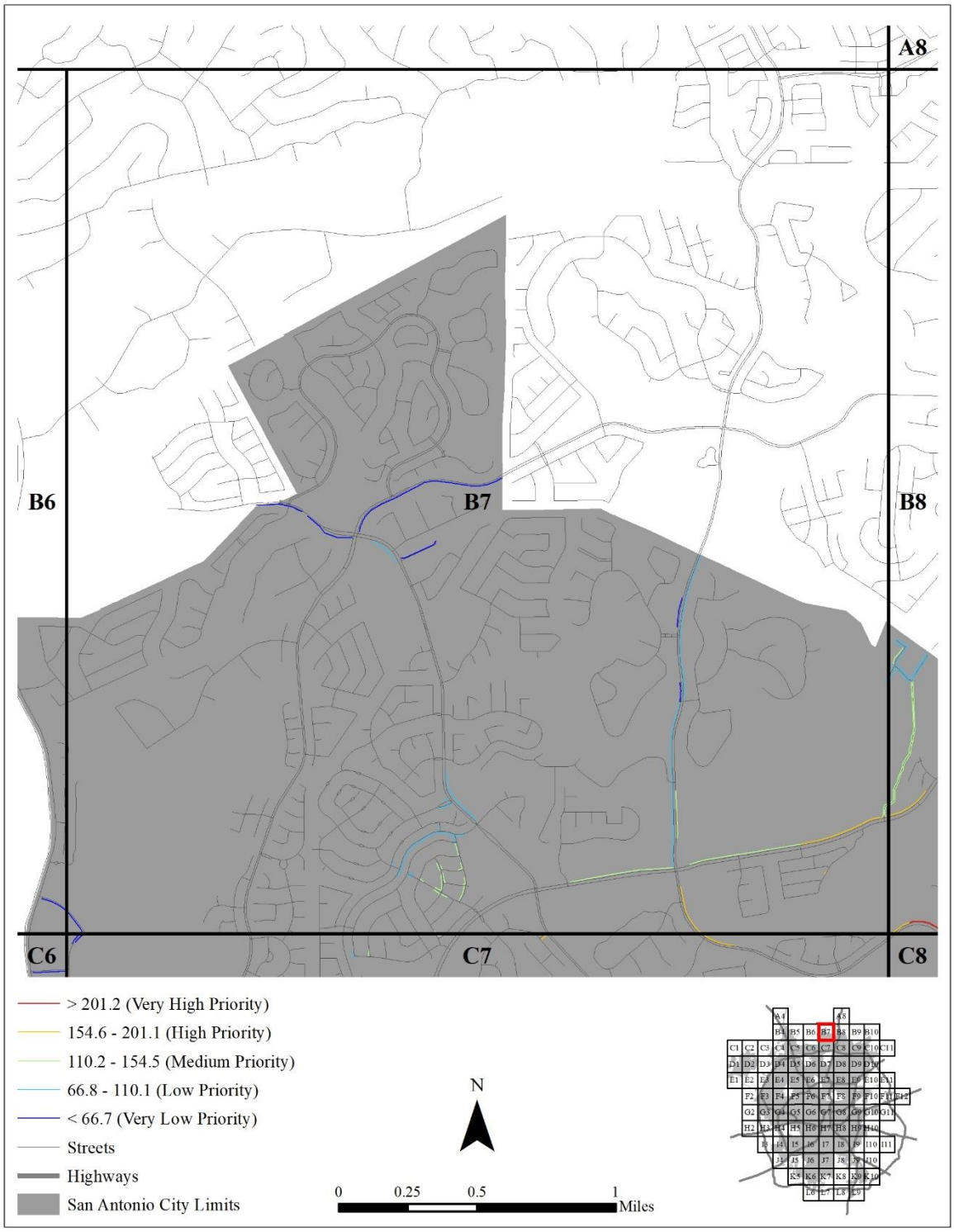

A4
B4
B5
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

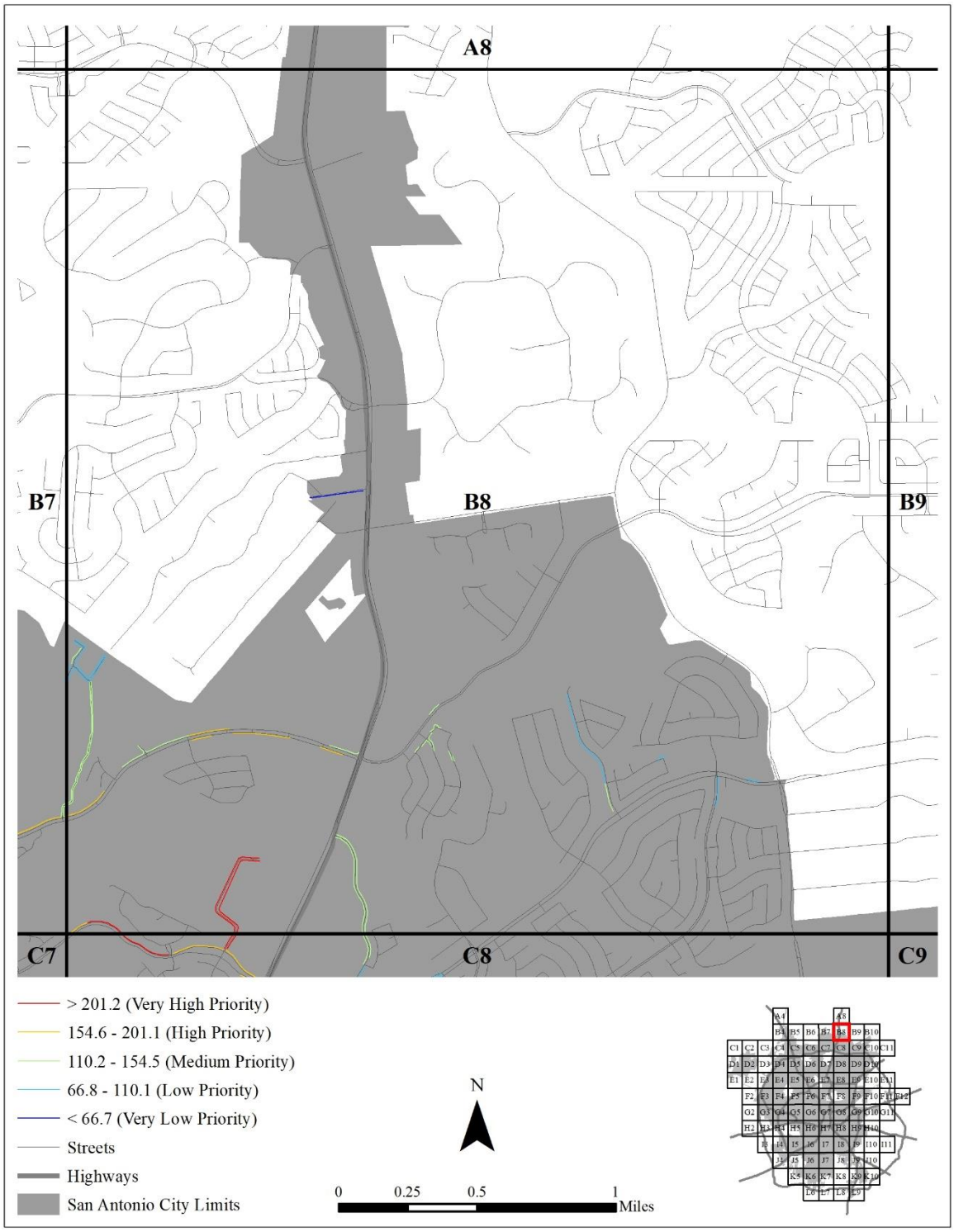

A8
B7
B8
B9
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

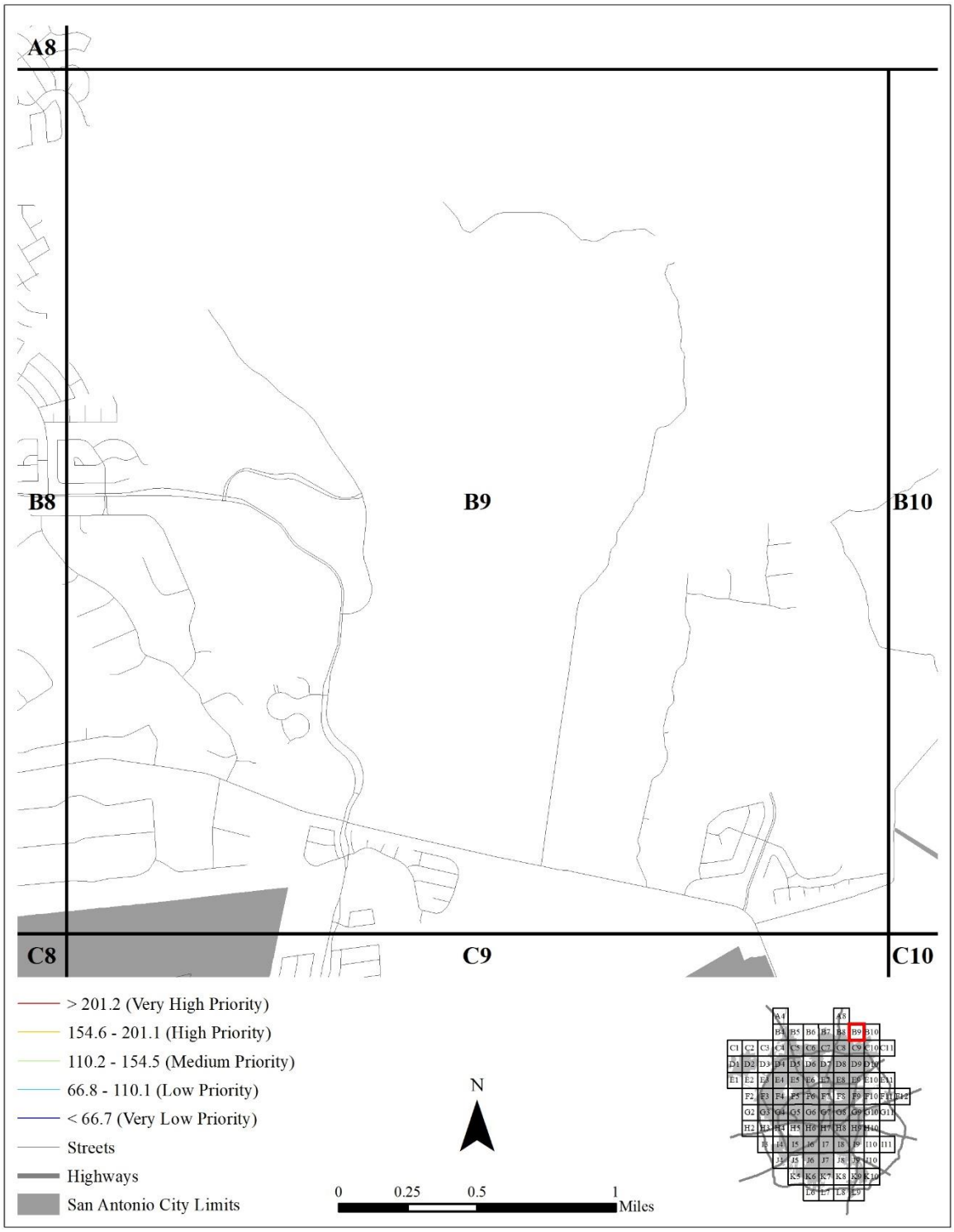

A4
B4
B5
C3
C4
C5
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

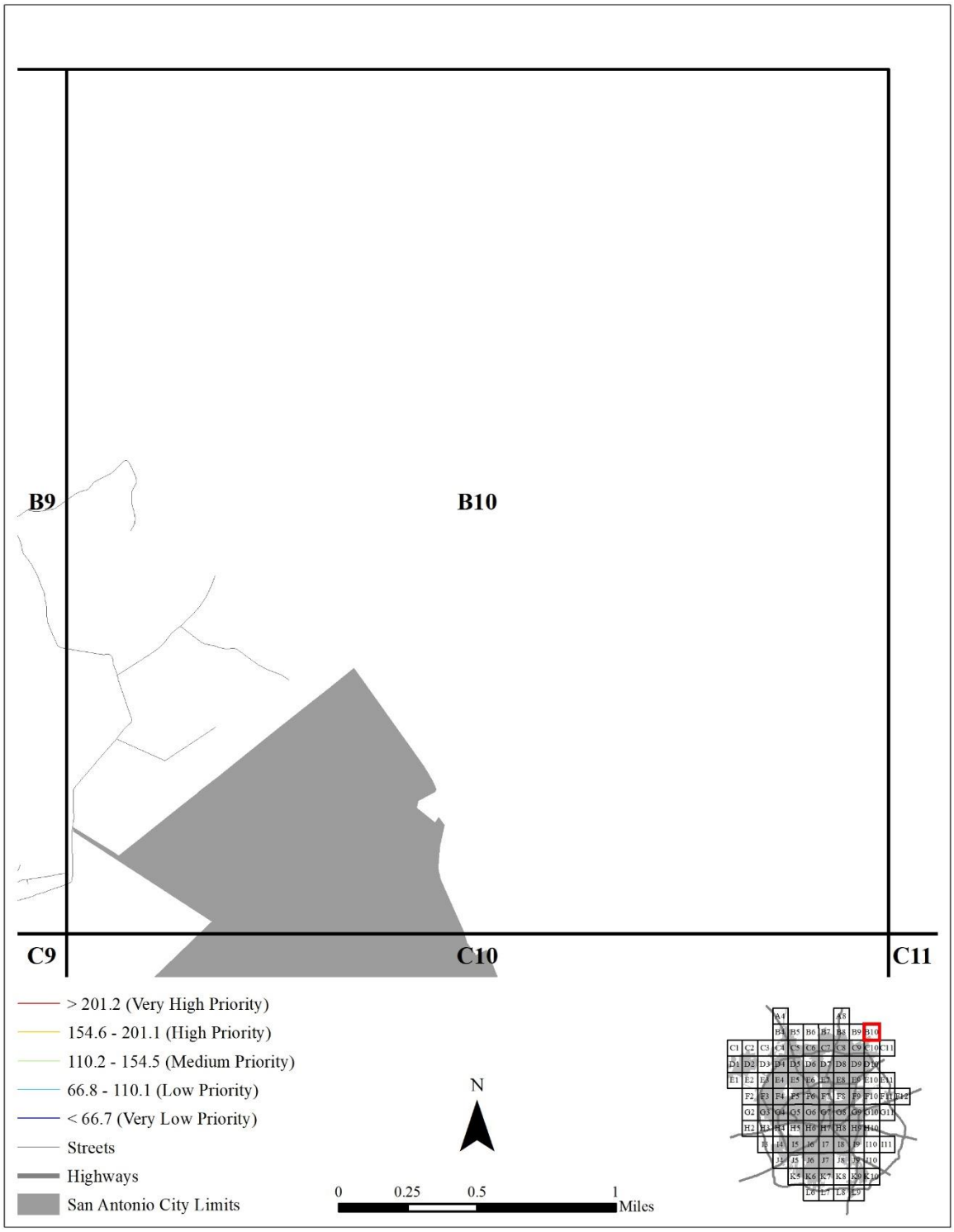

A4
B4
B5
B6
C4
C5
C6
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

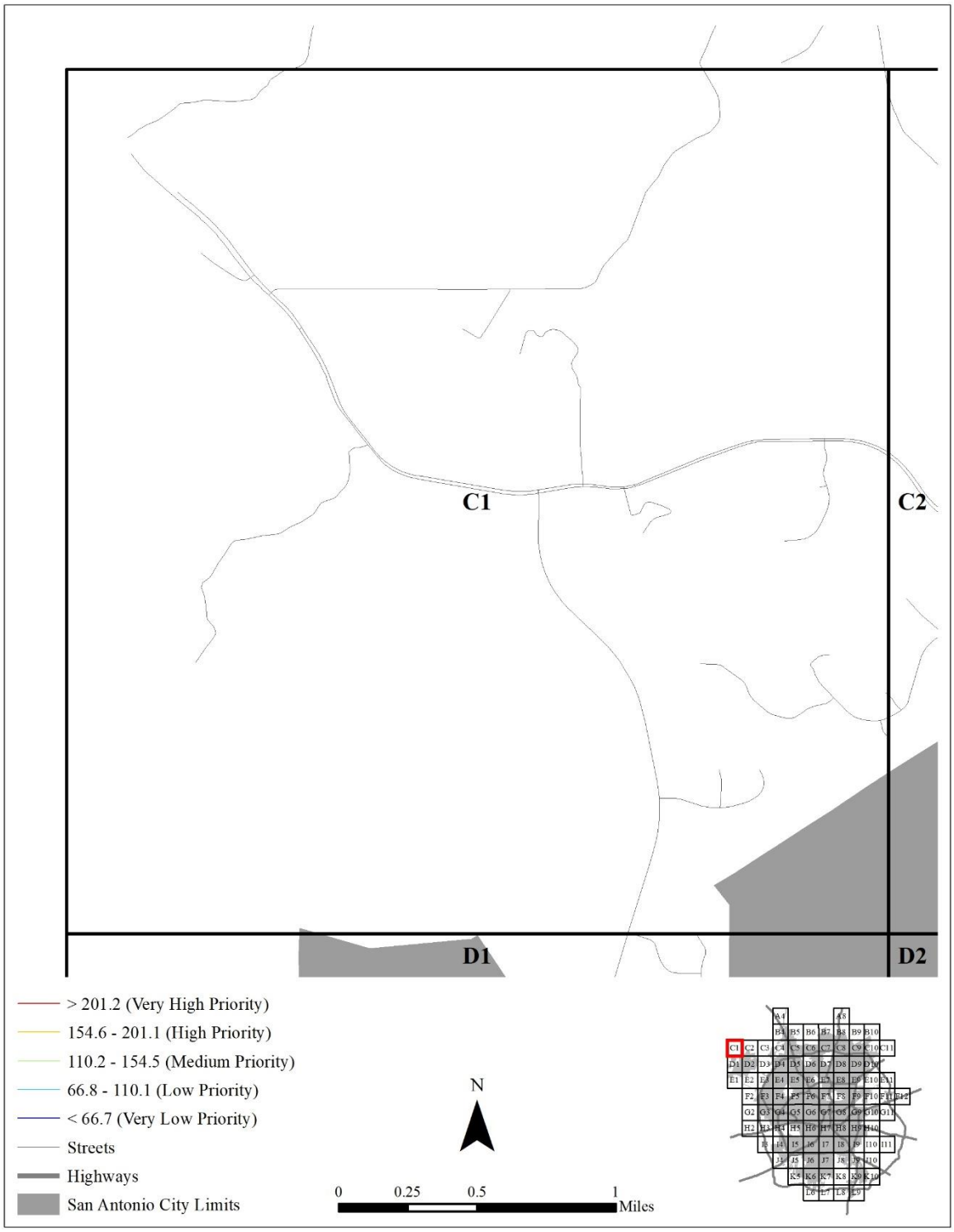

B5
B6
B7
C5
C6
C7
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

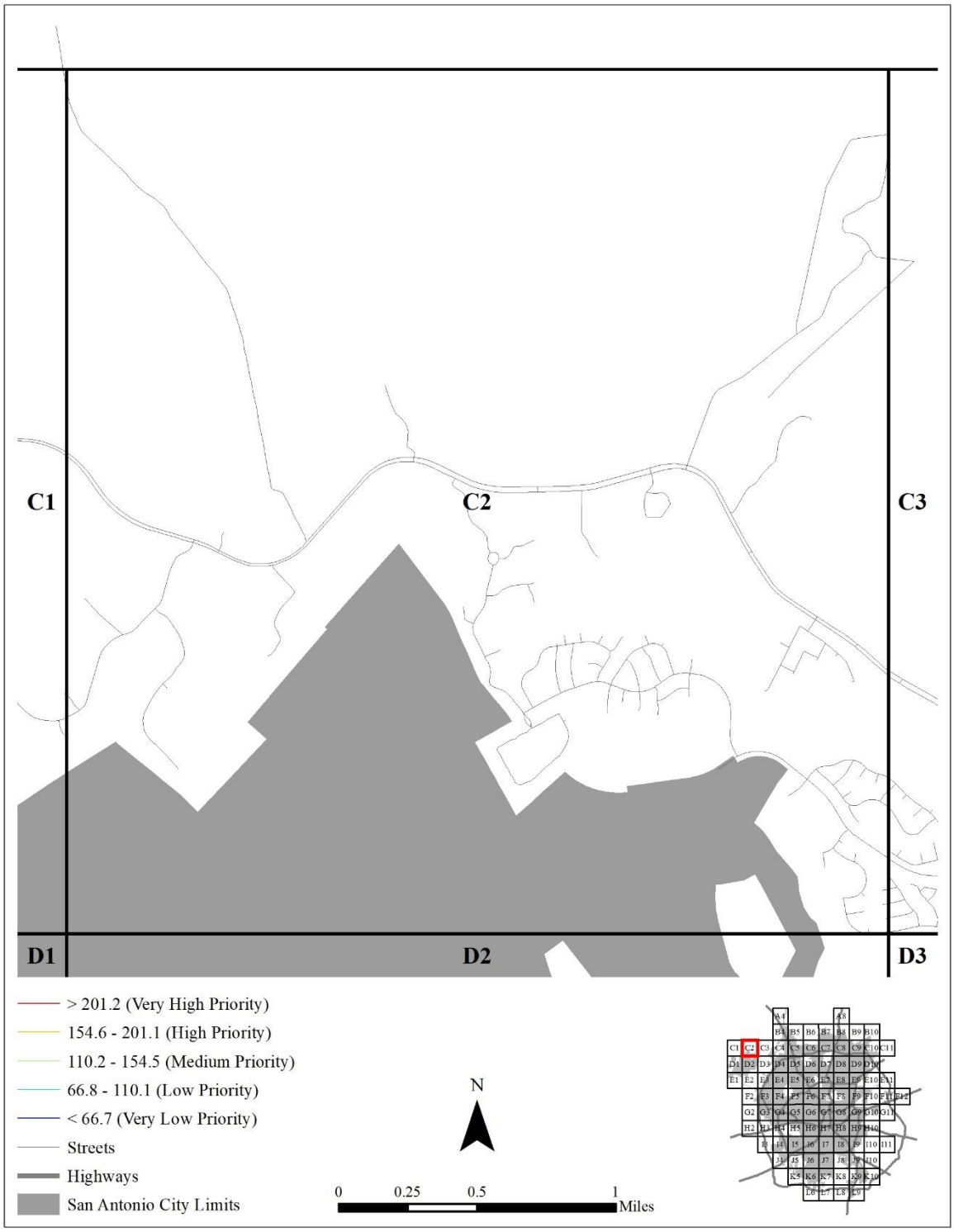

A8
B6
B7
B8
C6
C7
C8
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

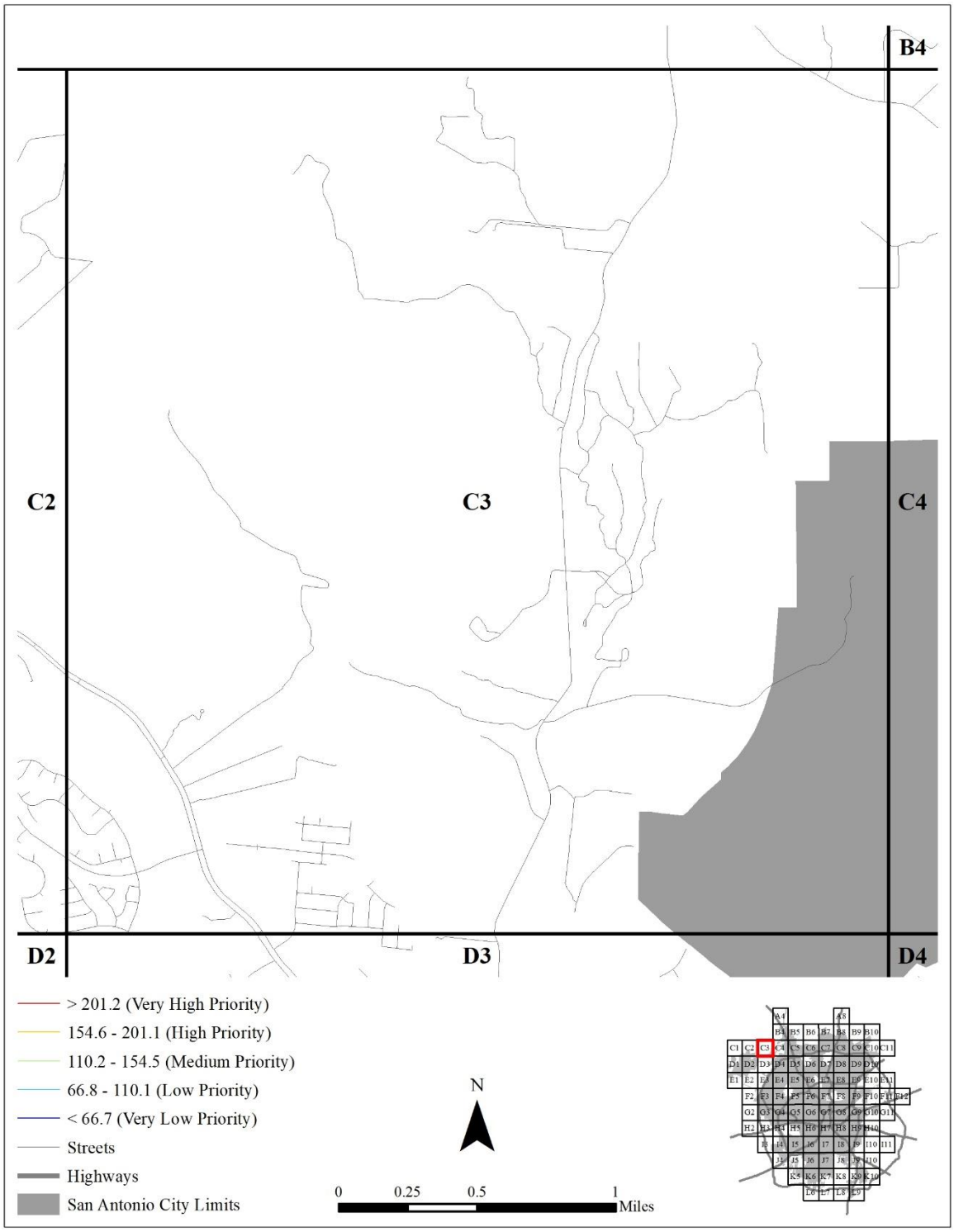

A8
B7
B8
B9
C7
C8
C9
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

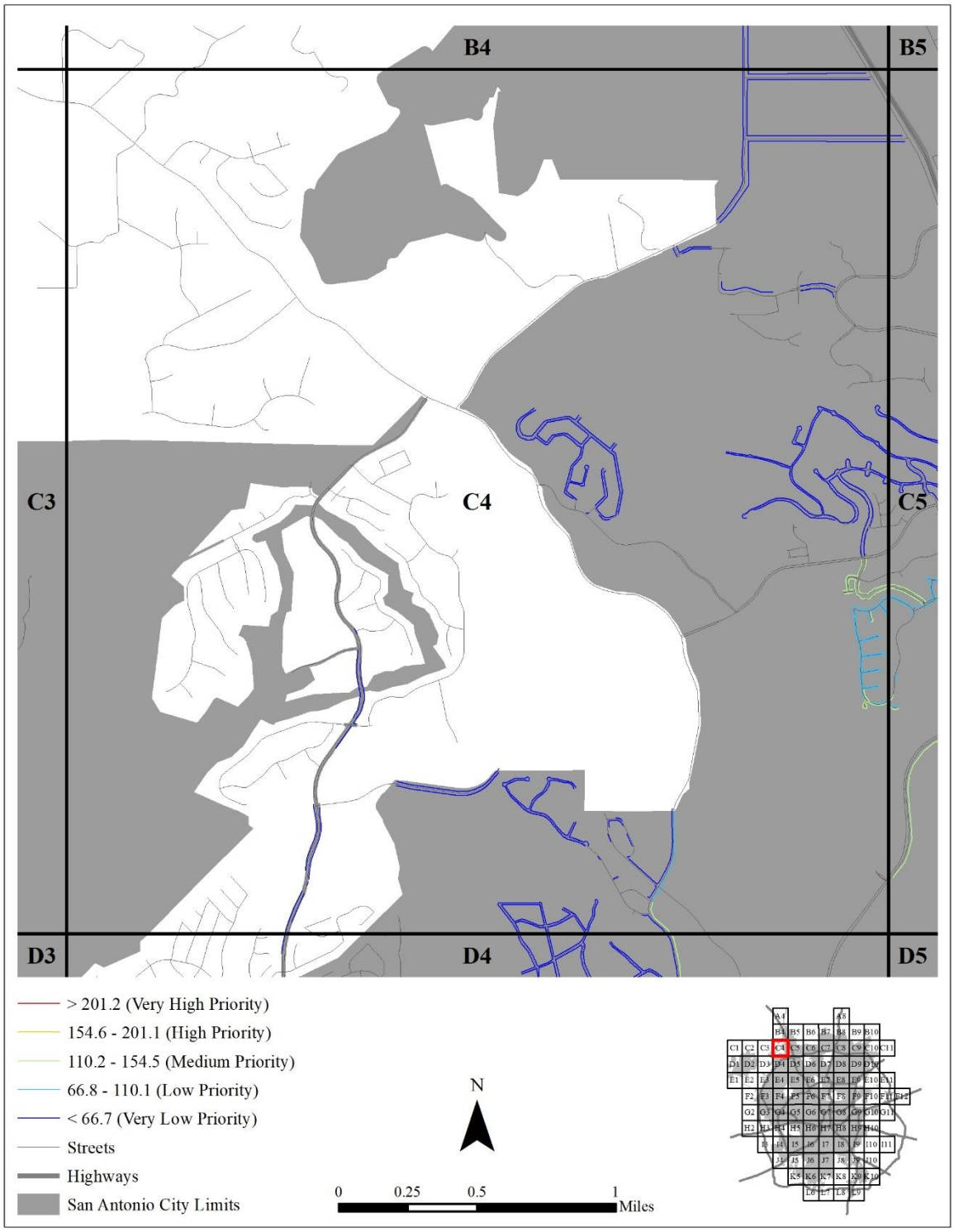

A8
B8
B9
B10
C8
C9
C10
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

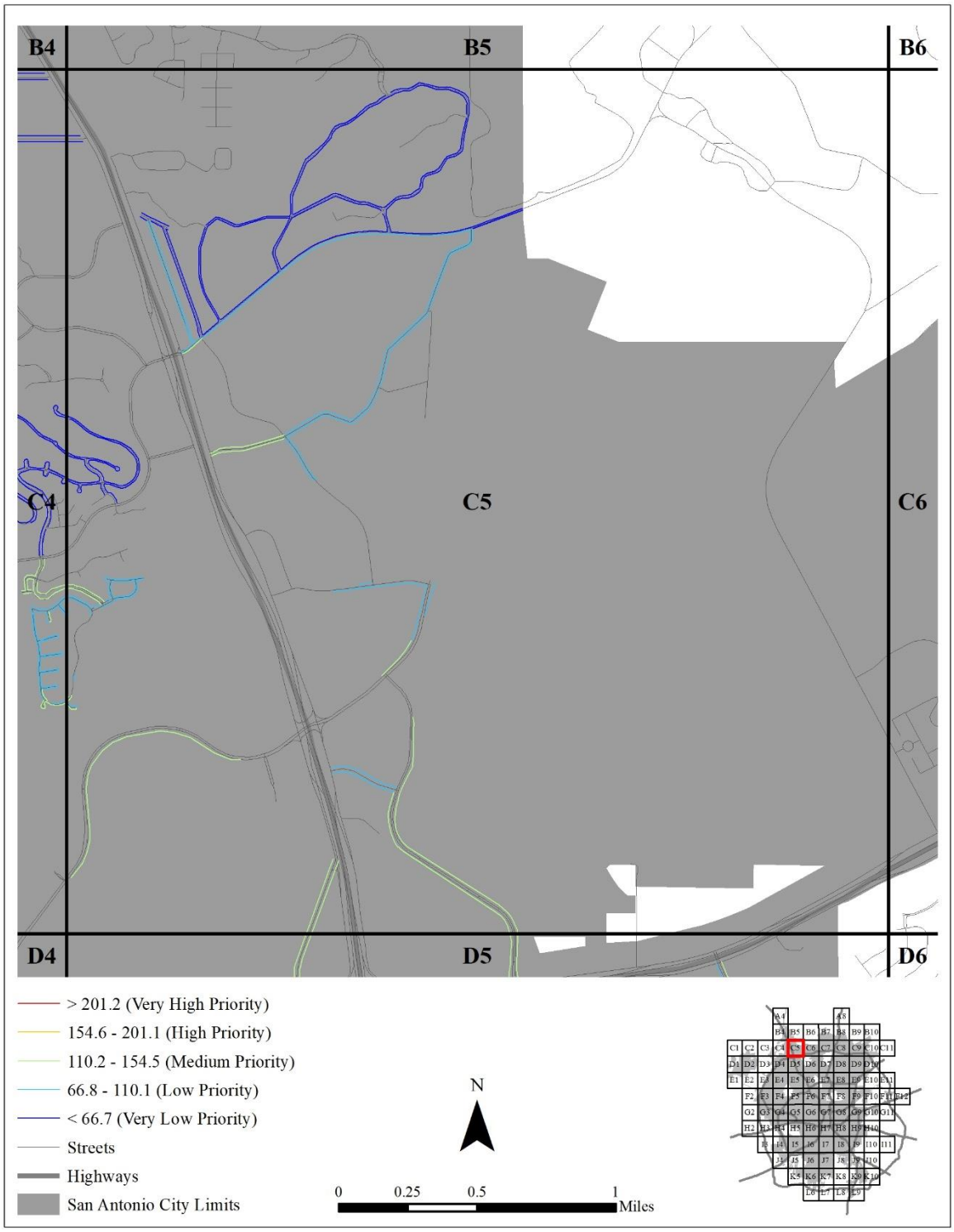

B9
B10
C9
C10
C11
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

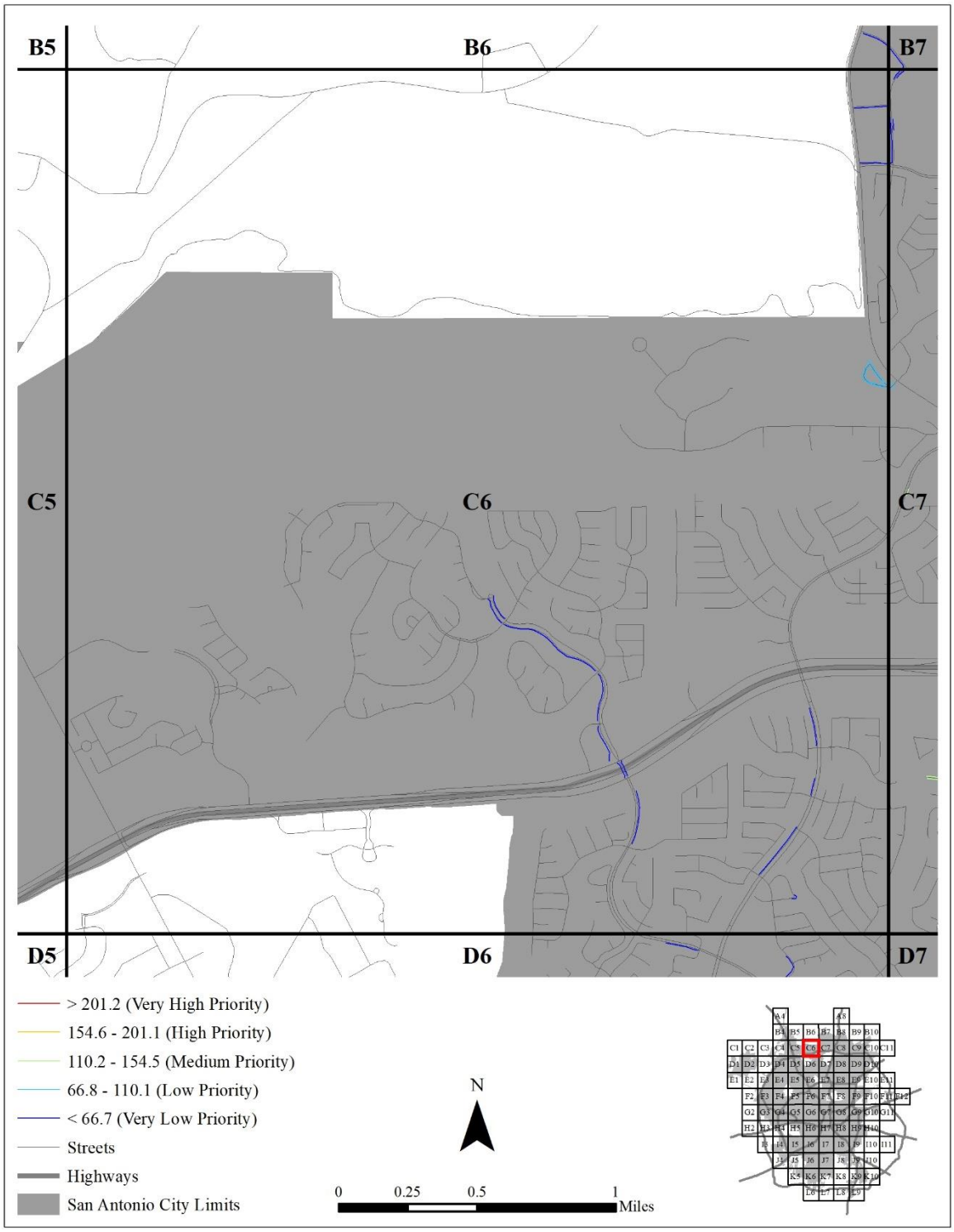

C1
C2
D1
D2
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

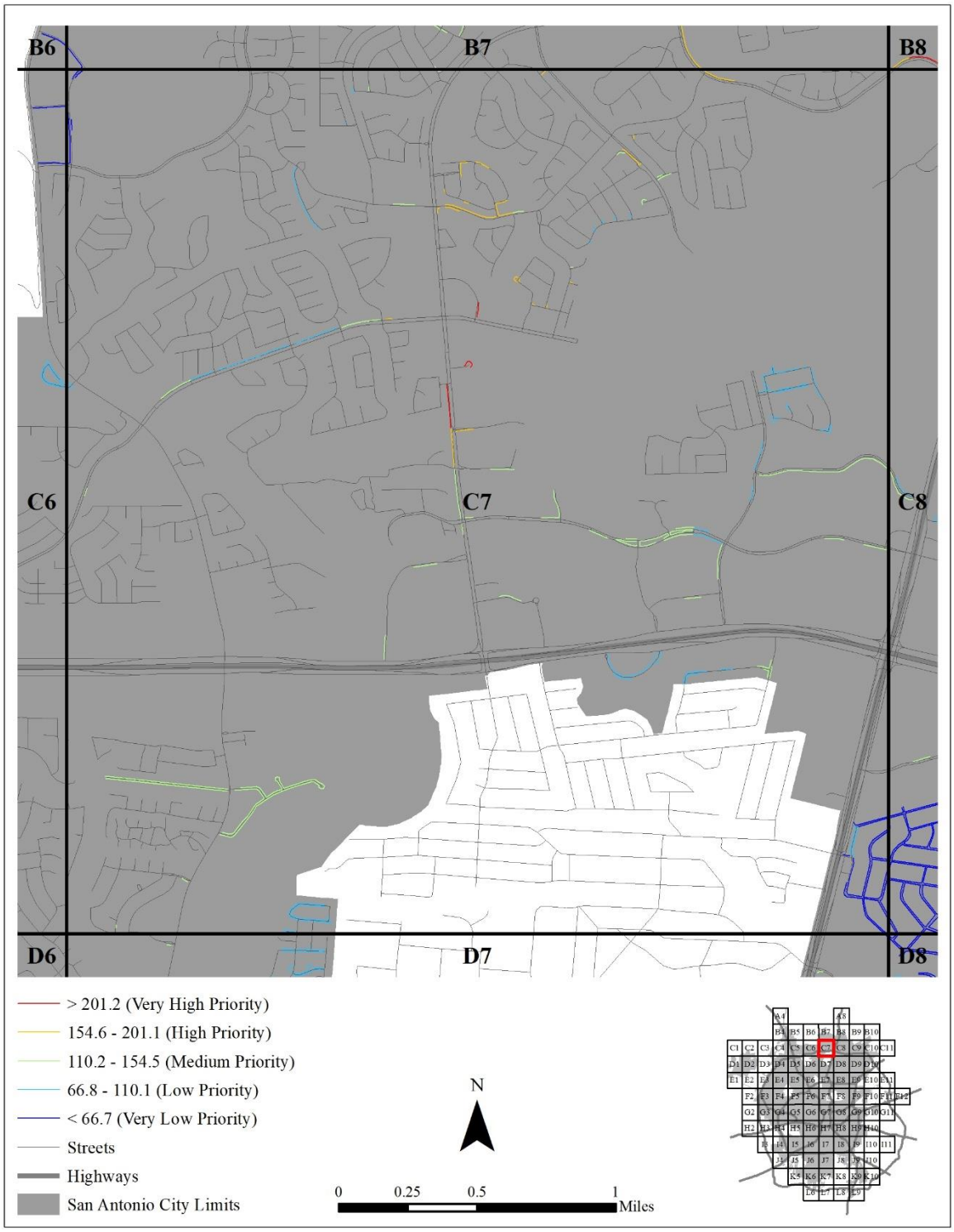

C1
C2
C3
D1
D2
D3
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

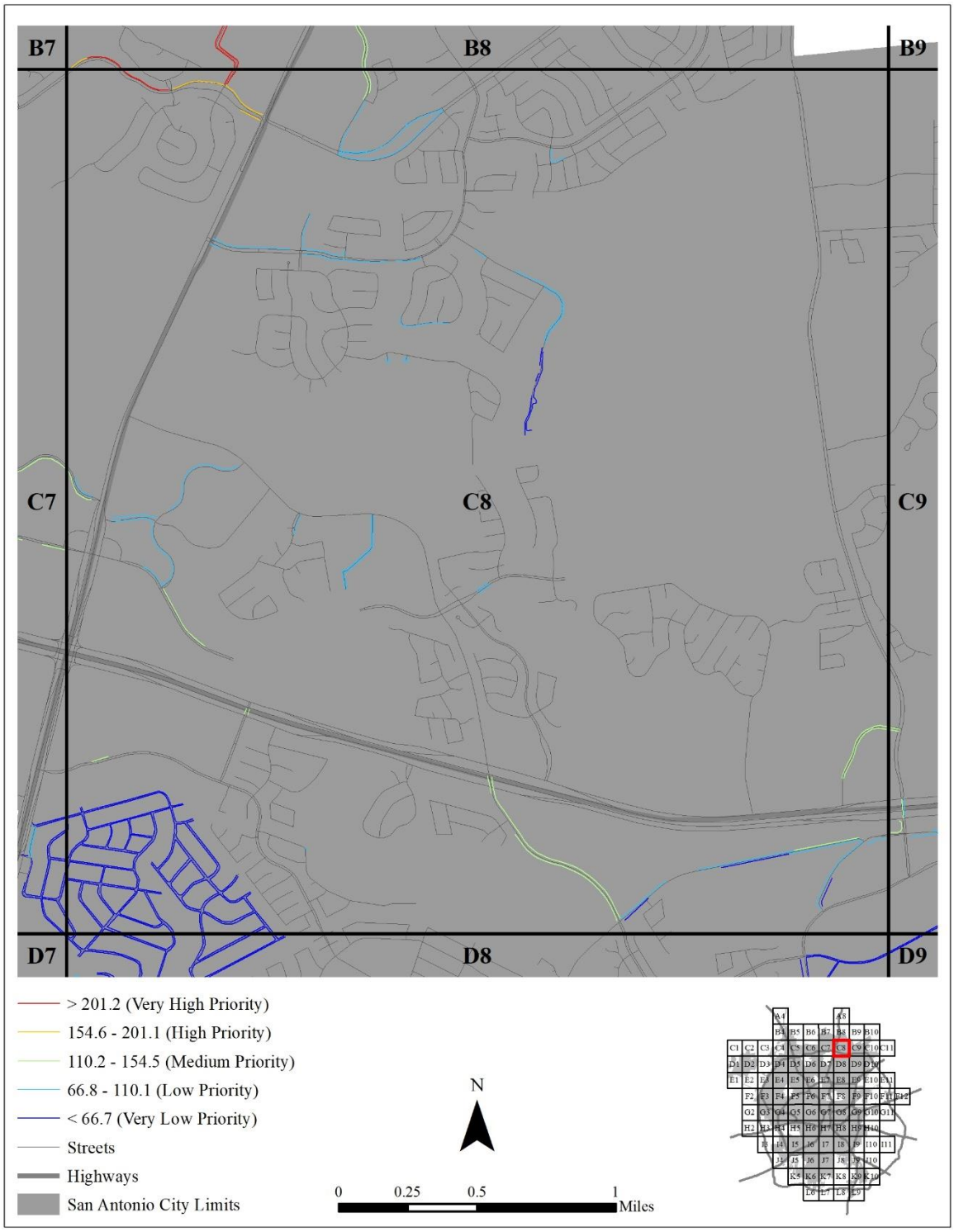

B4
C2
C3
C4
D2
D3
D4
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

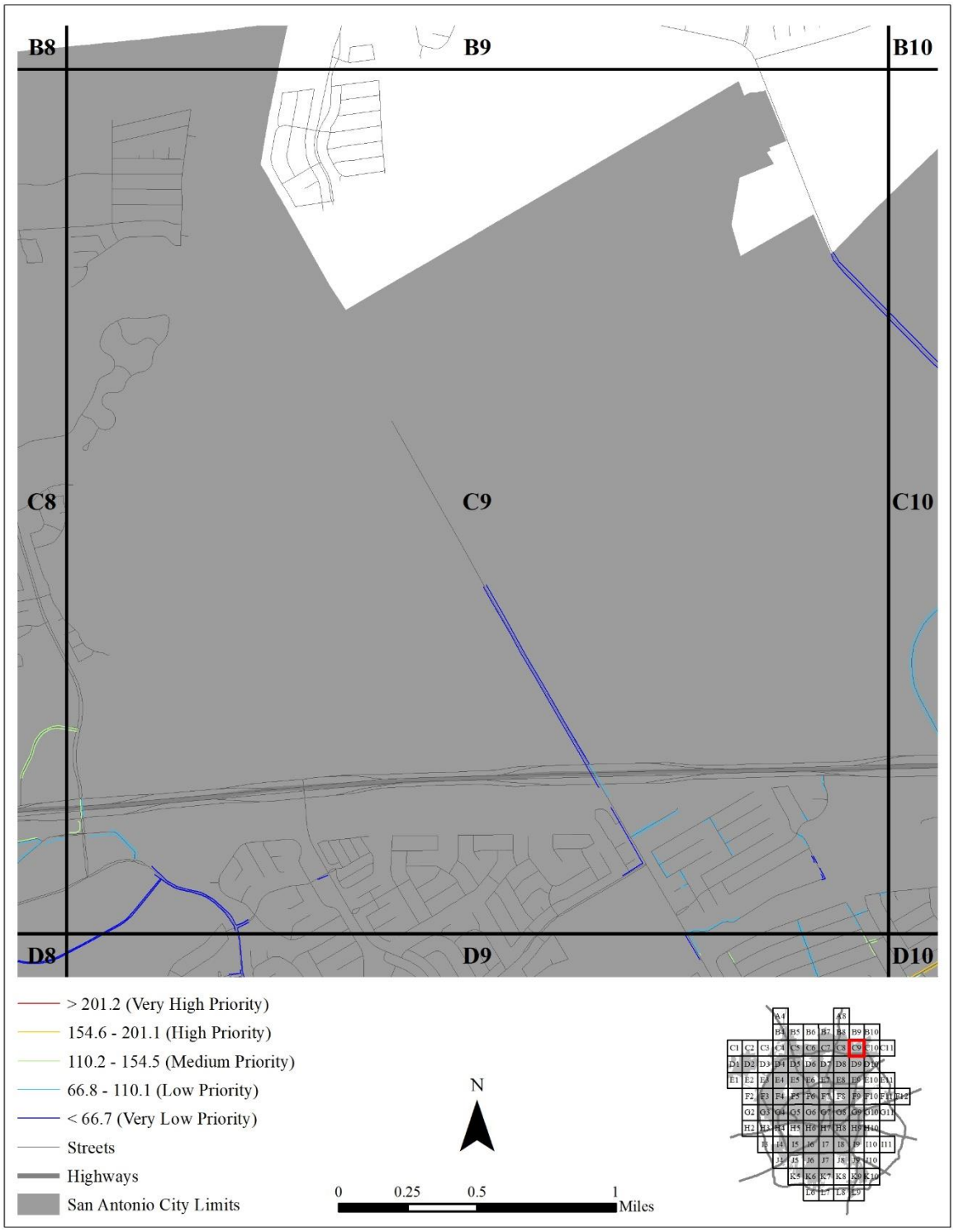

B4
B5
C3
C4
C5
D3
D4
D5
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

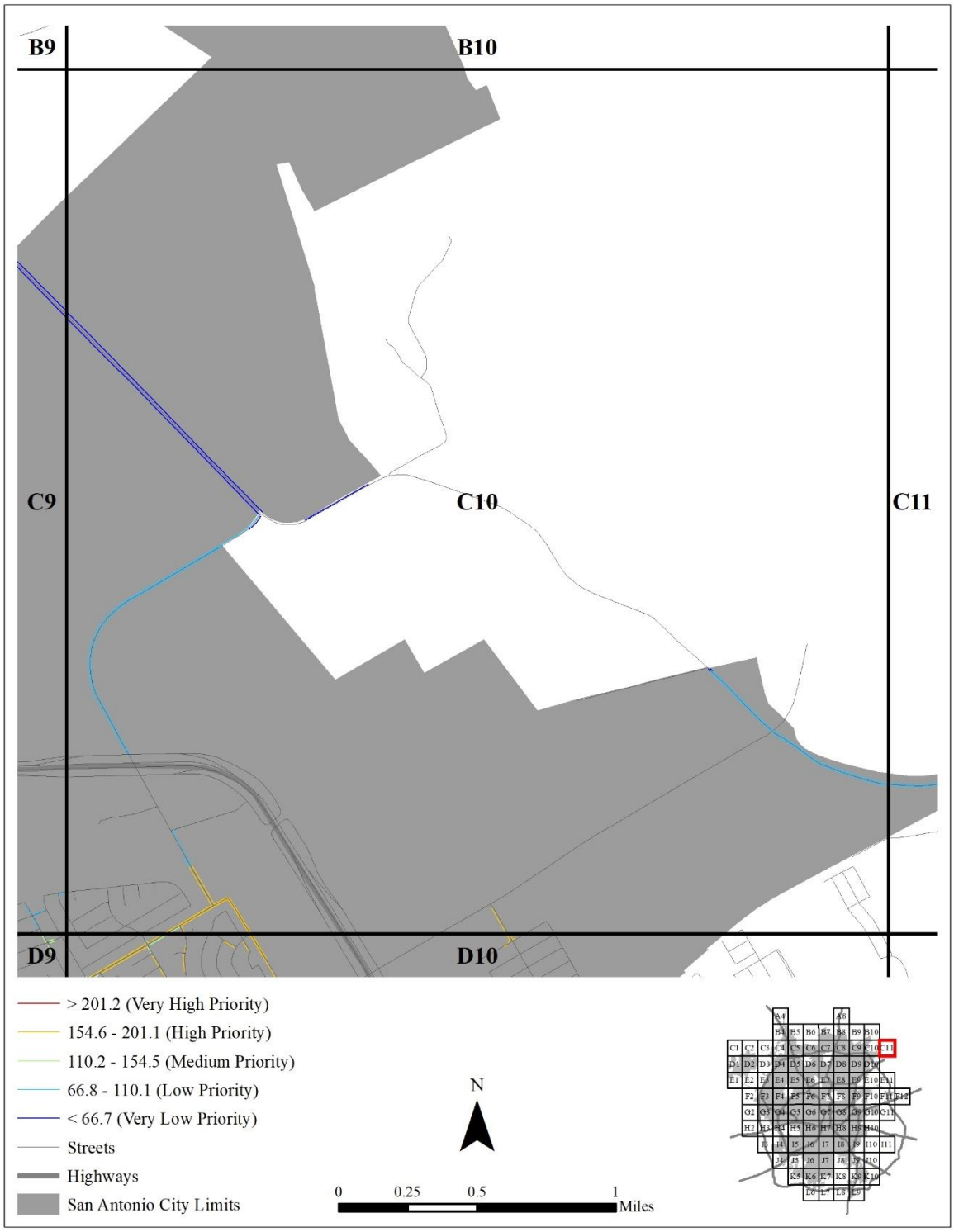

B4
B5
B6
C4
C5
C6
D4
D5
D6
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

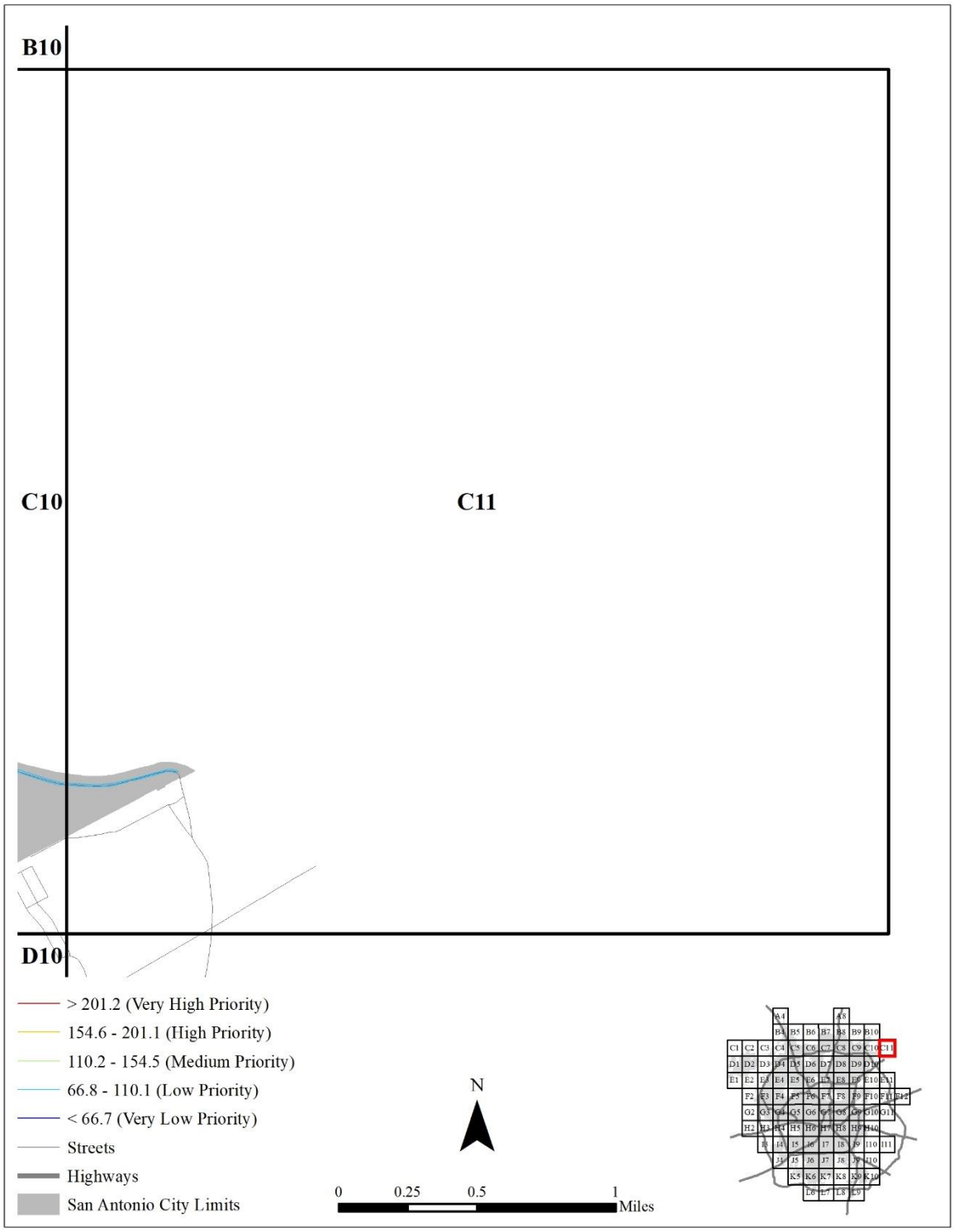

B5
B6
B7
C5
C6
C7
D5
D6
D7
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

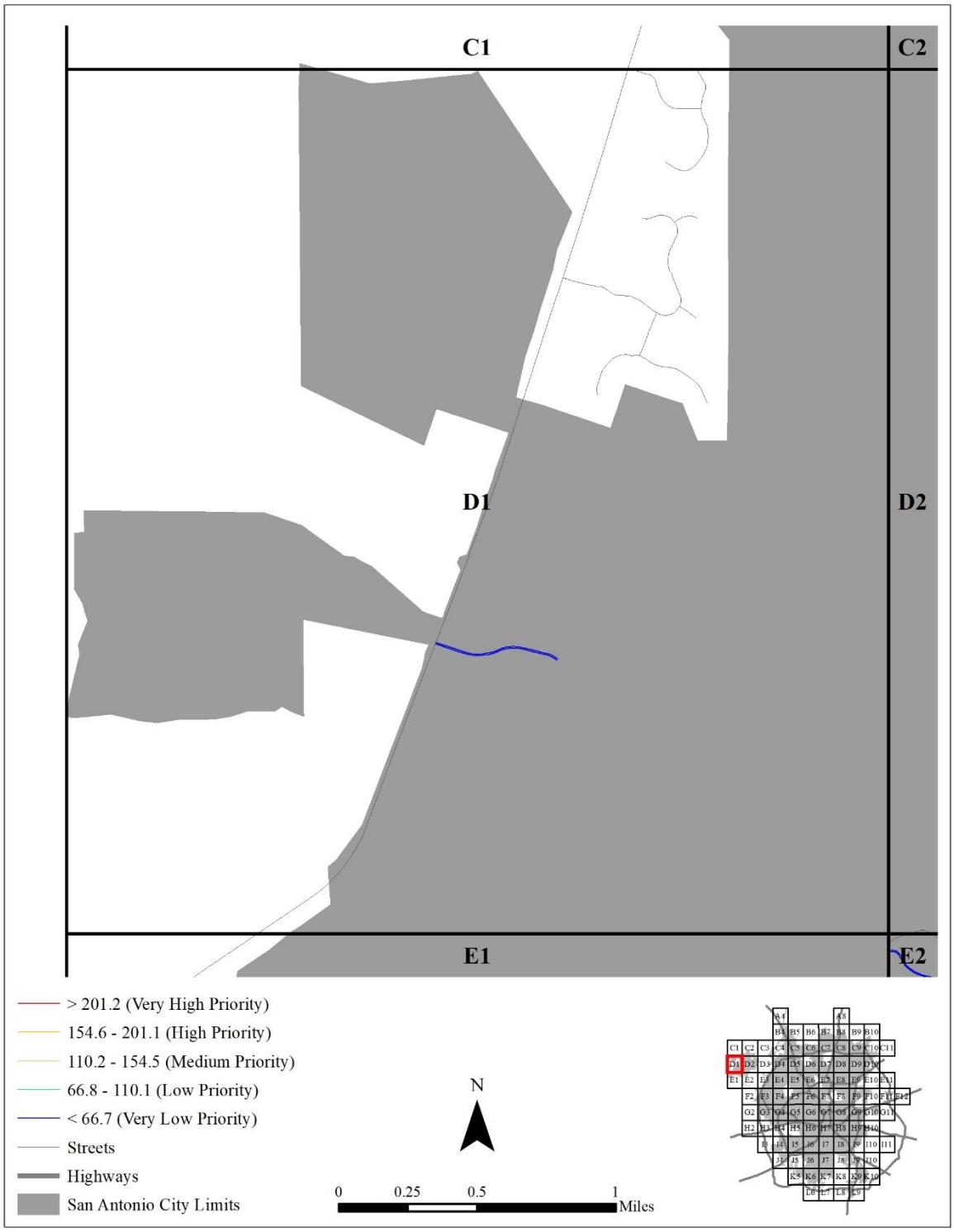

B6
B7
B8
C6
C7
C8
D6
D7
D8
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

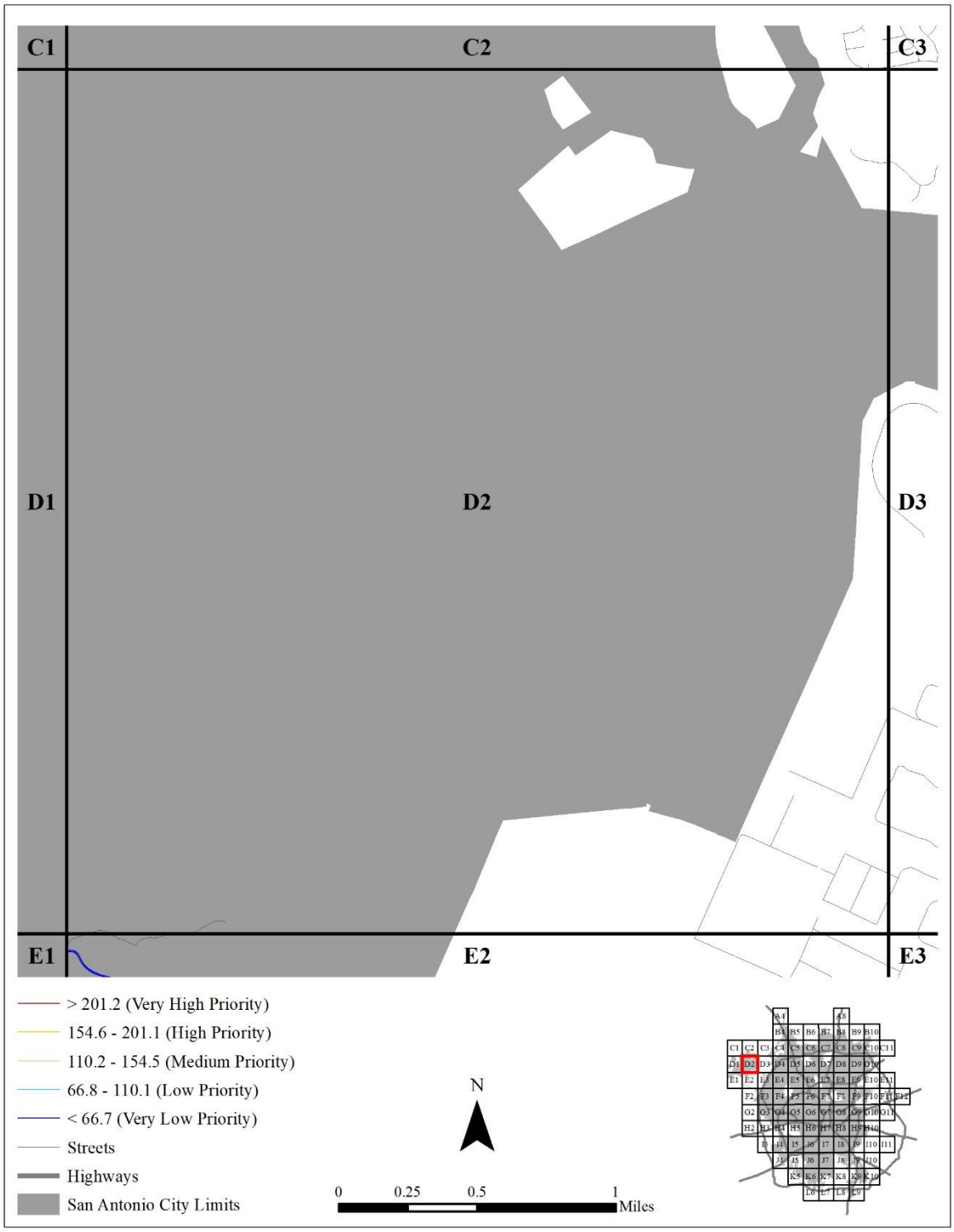

B7
B8
B9
C7
C8
C9
D7
D8
D9
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

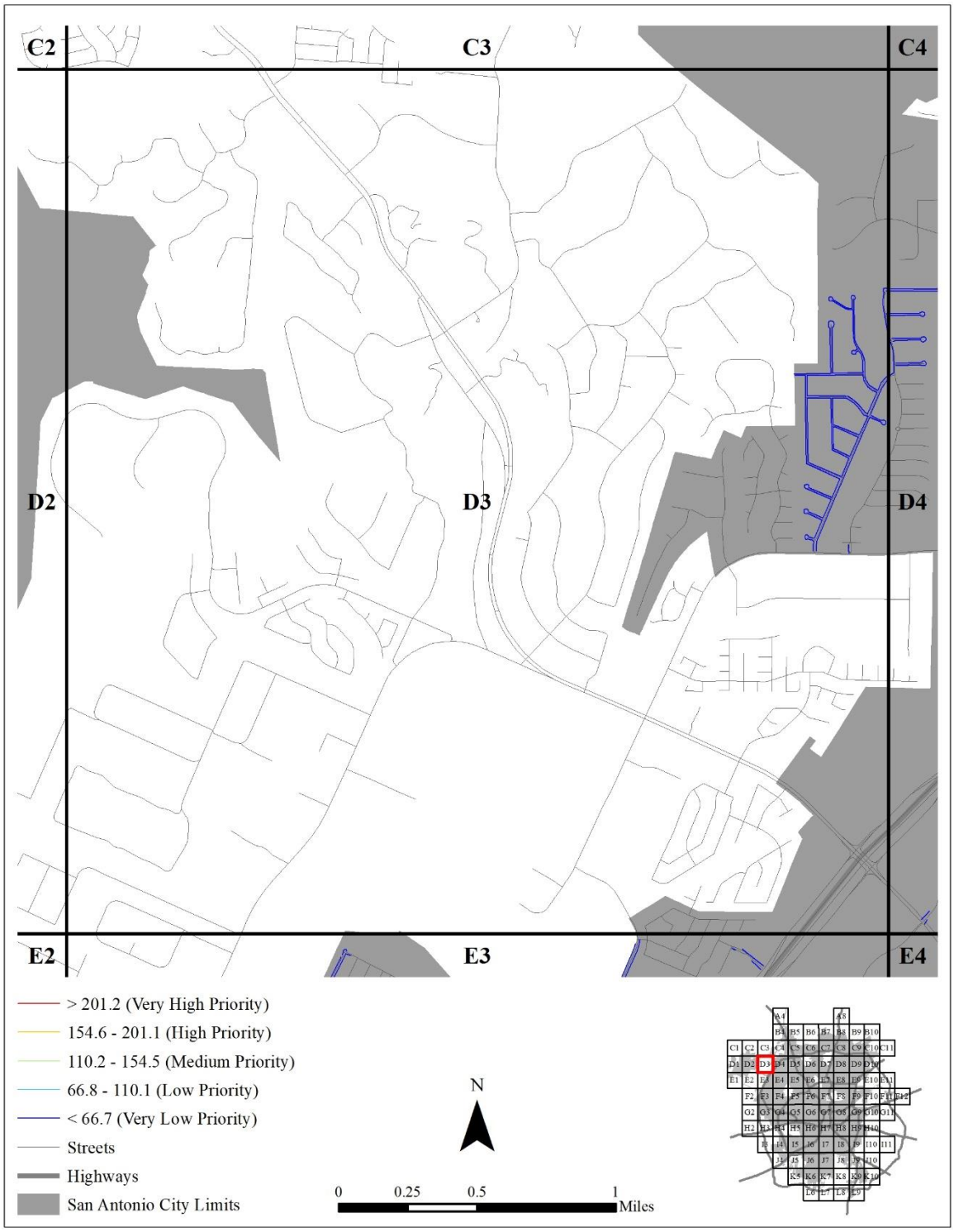

B8
B9
B10
C8
C9
C10
D8
D9
D10
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

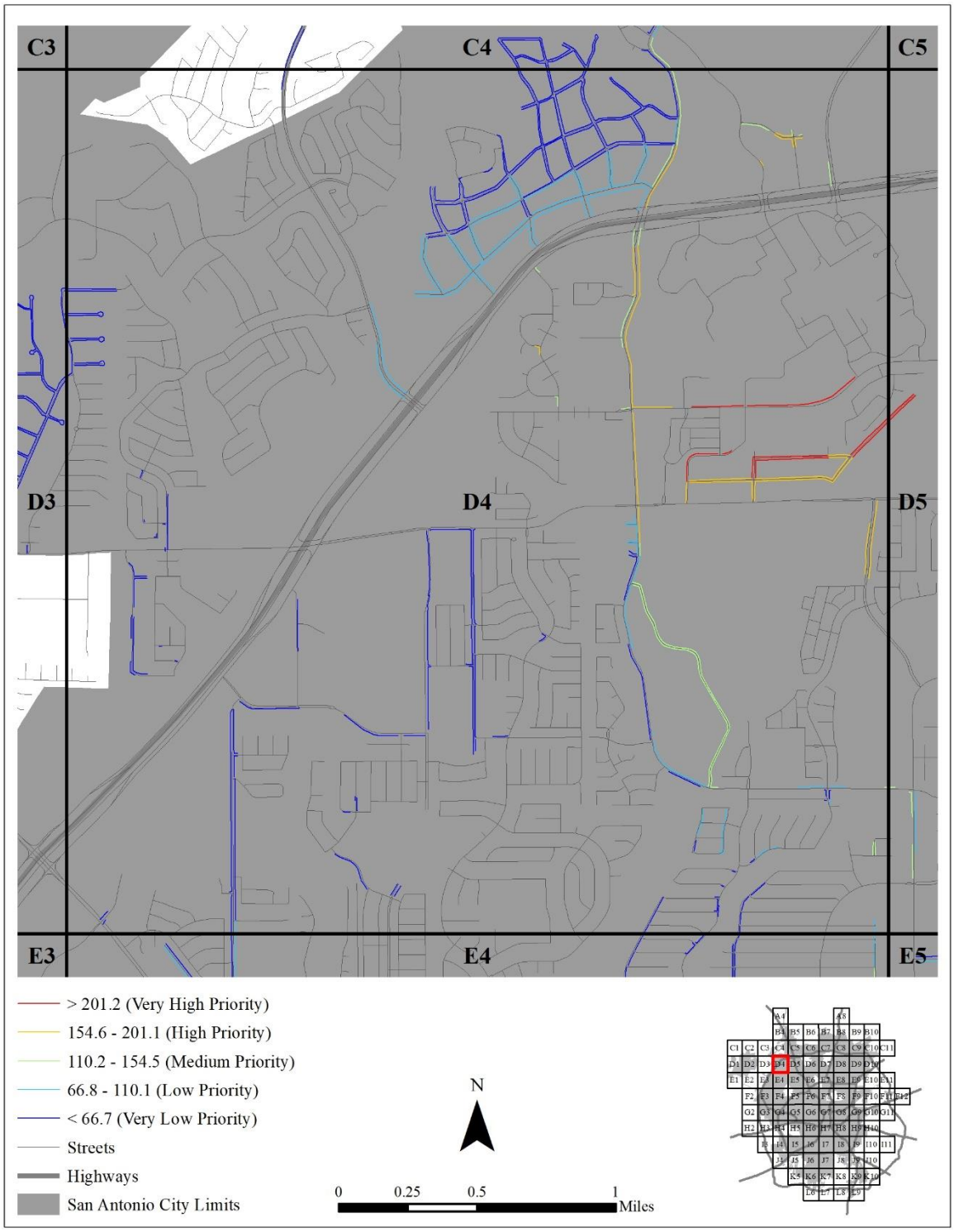

B9
B10
C9
C10
C11
D9
D10
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles


B10
C10
C11
D10
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

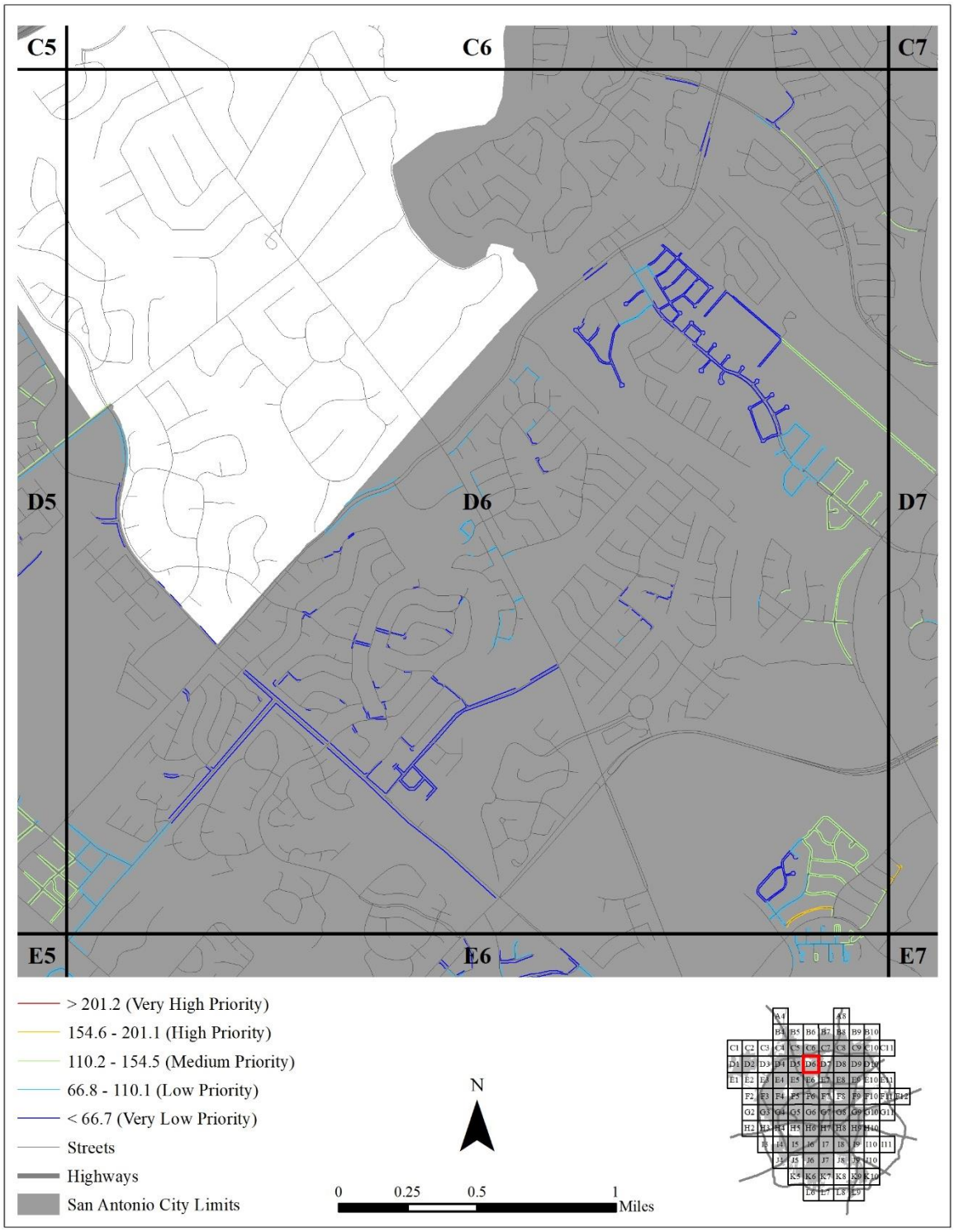

C1
C2
D1
D2
E1
E2
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

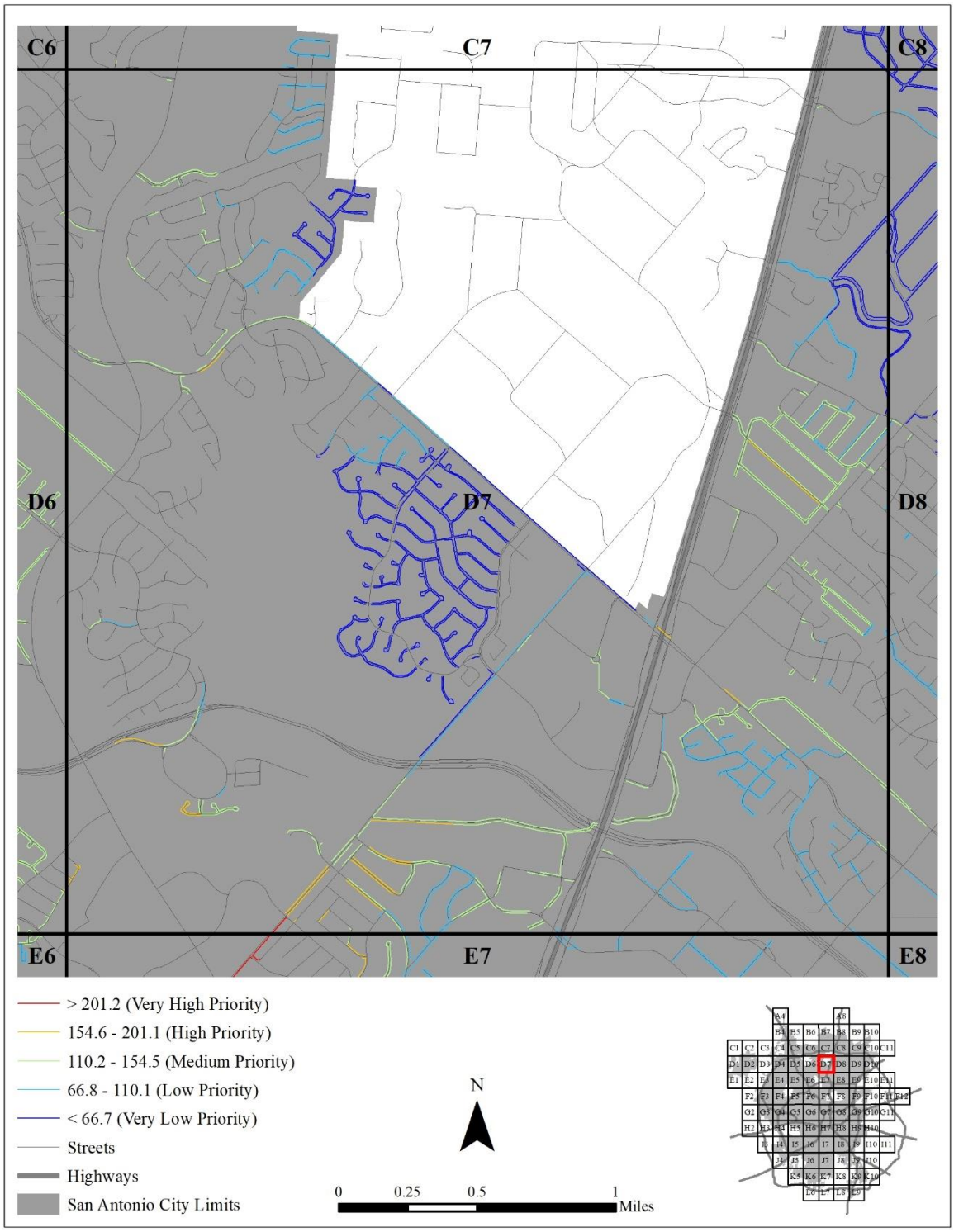

C1
C2
C3
D1
D2
D3
E1
E2
E3
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

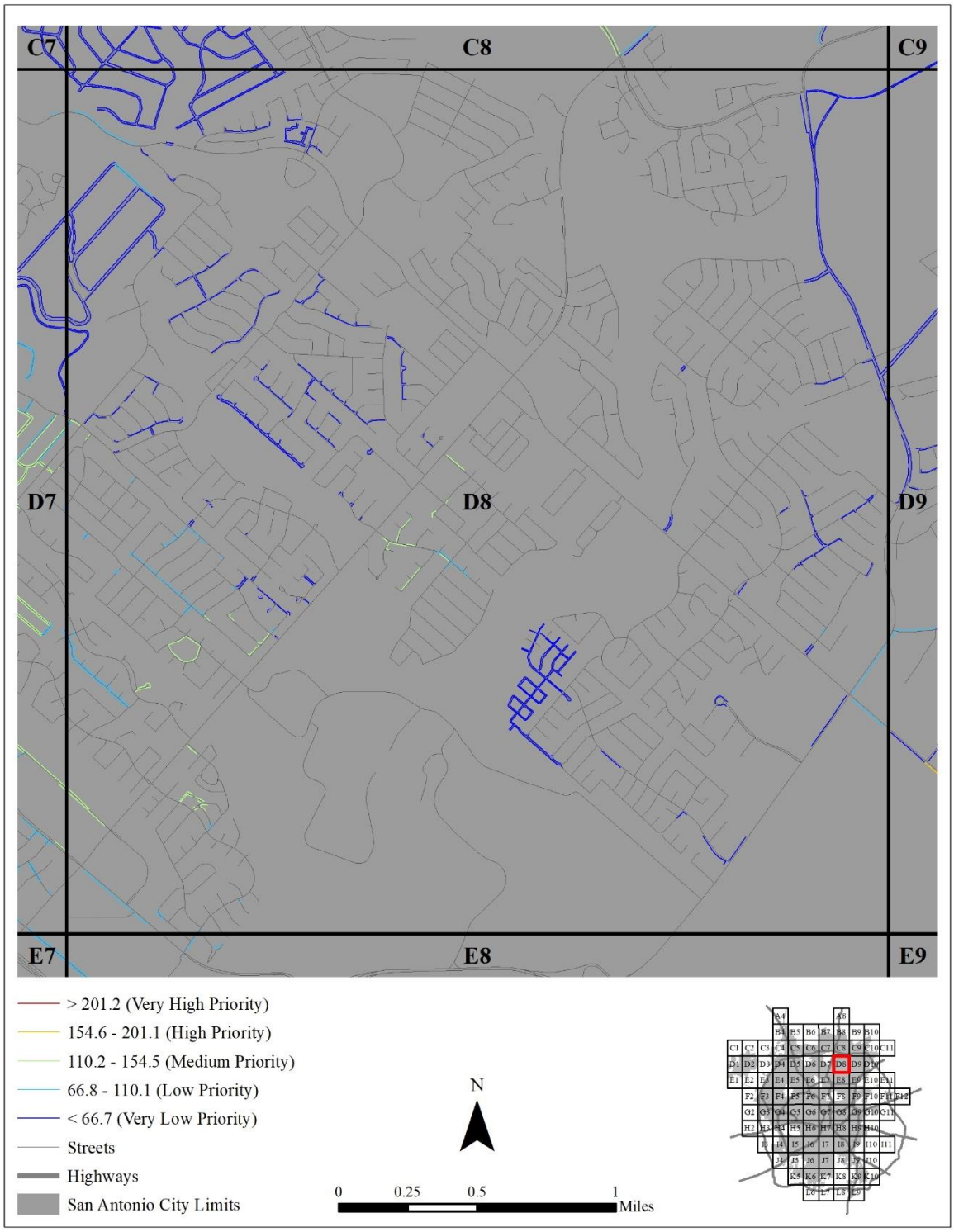

C2
C3
C4
D2
D3
D4
E2
E3
E4
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

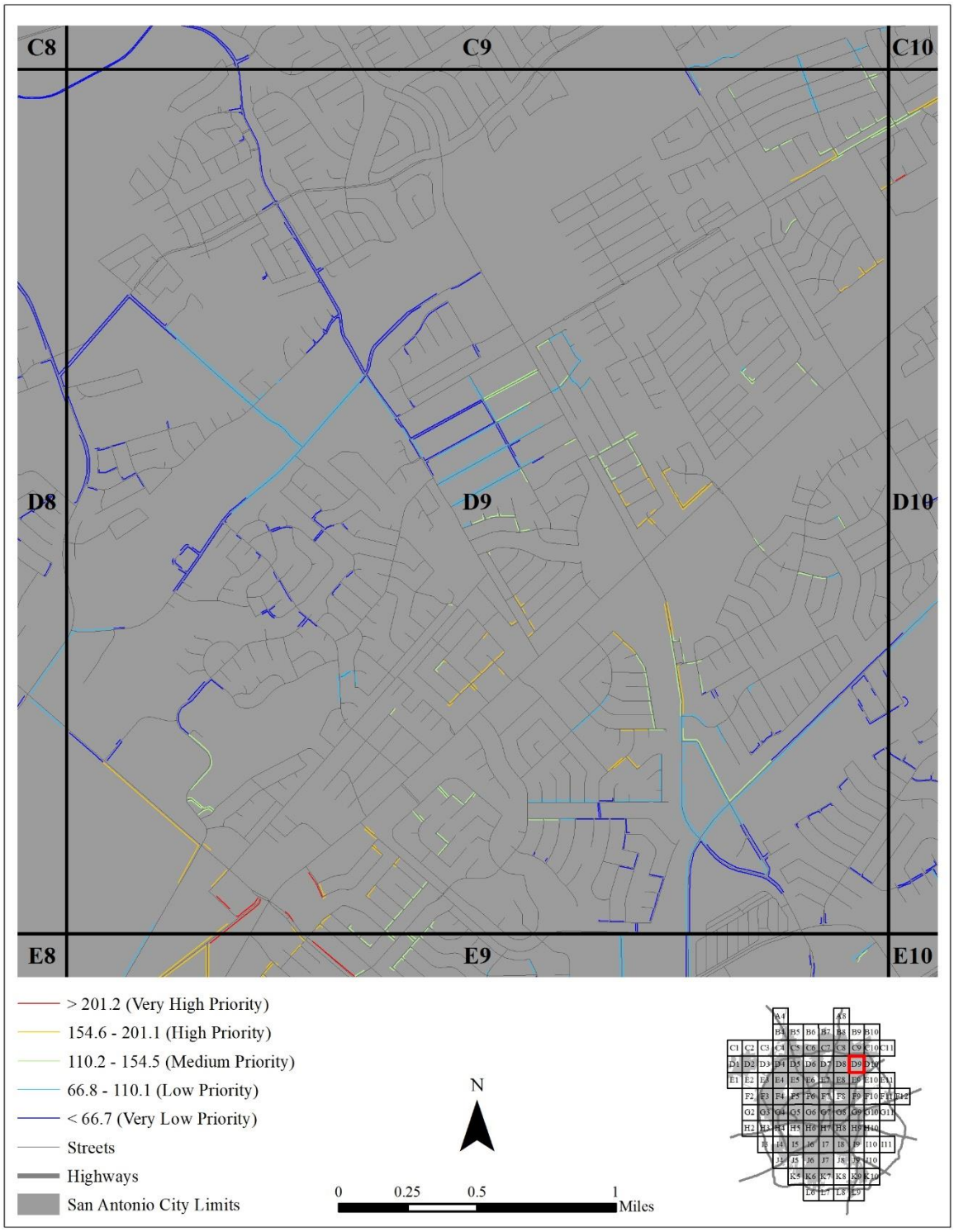

C3
C4
C5
D3
D4
D5
E3
E4
E5
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

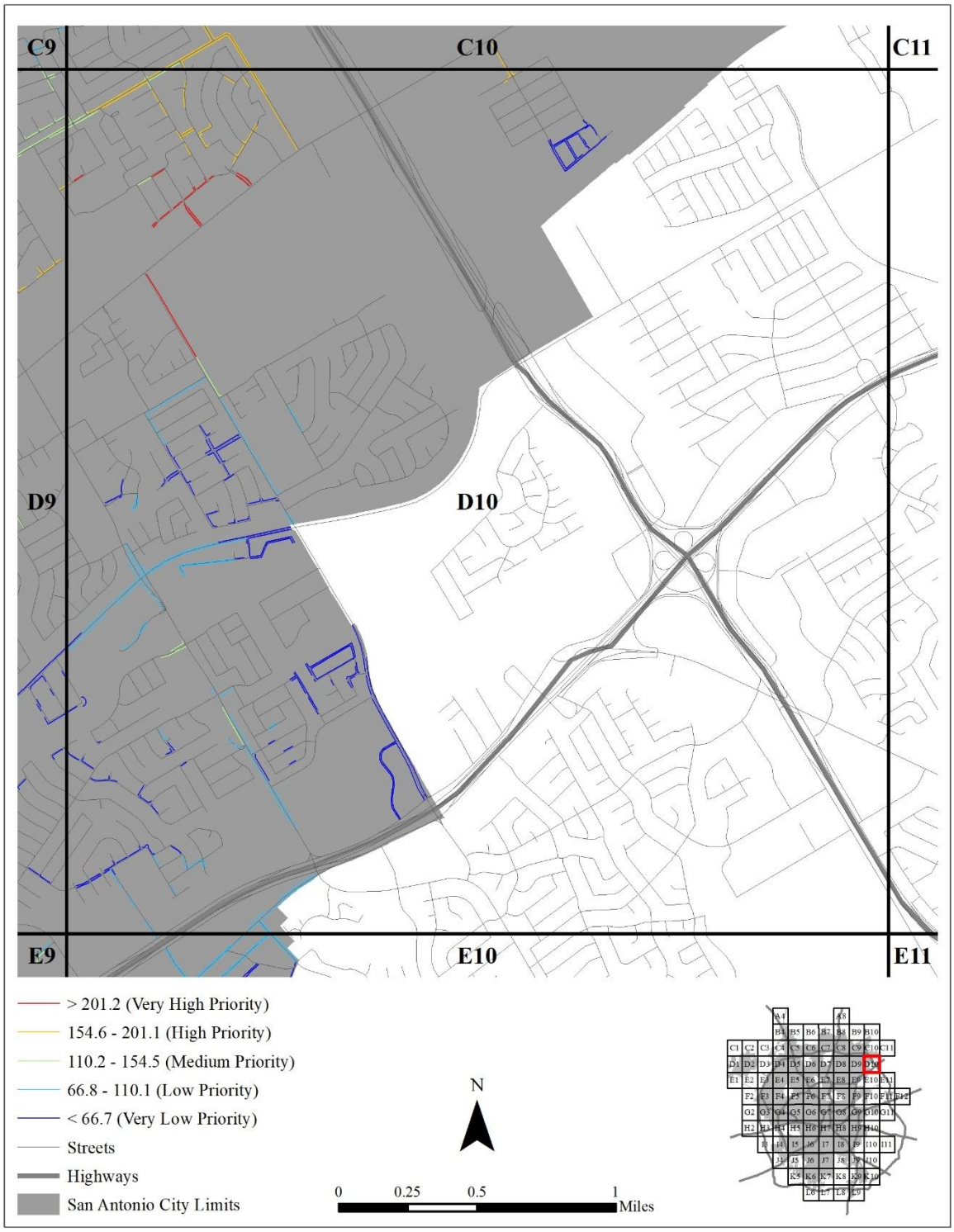

C4
C5
C6
D4
D5
D6
E4
E5
E6
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

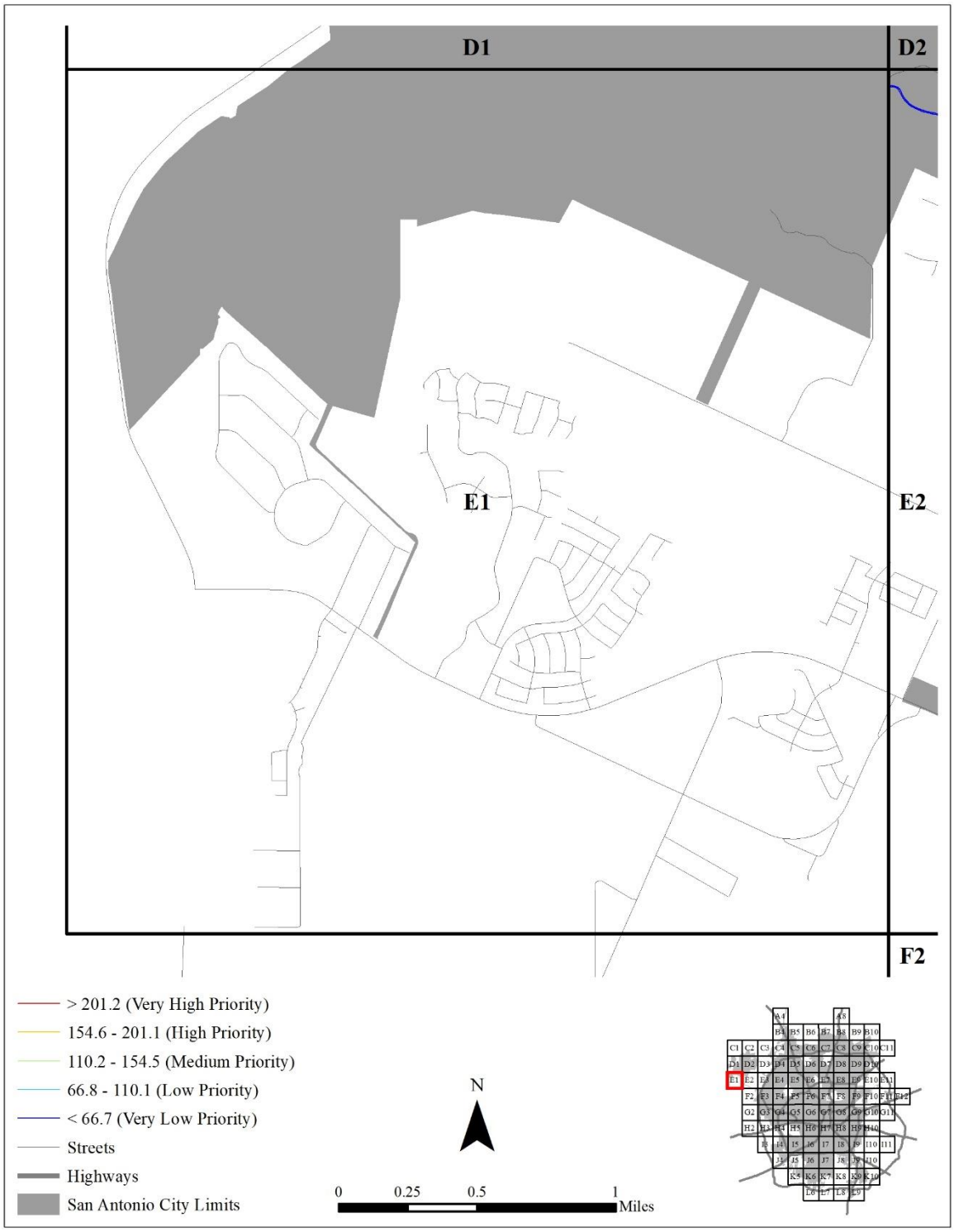

C5
C6
C7
D5
D6
D7
E5
E6
E7
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles


C6
C7
C8
D6
D7
D8
E6
E7
E8
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

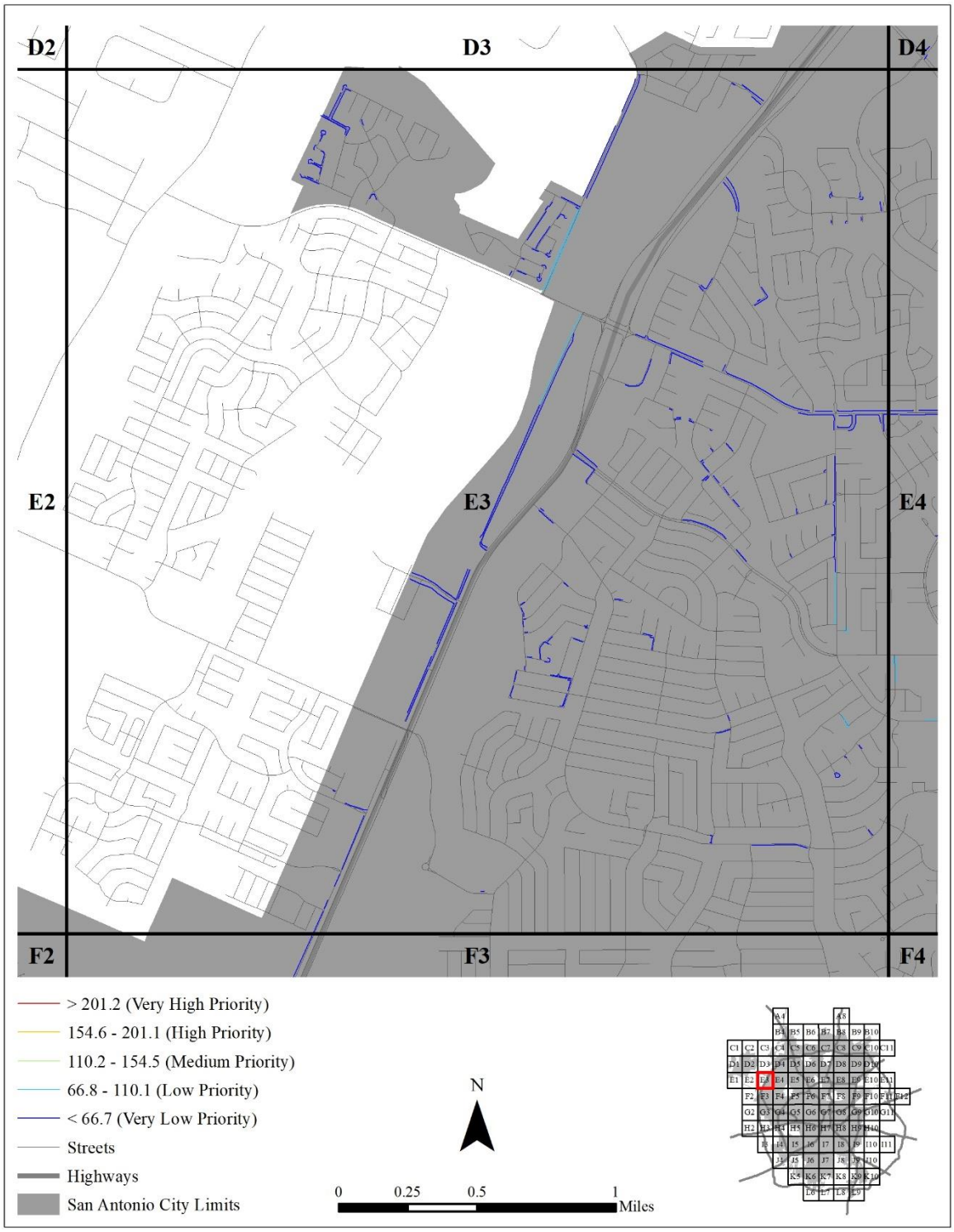

C7
C8
C9
D7
D8
D9
E7
E8
E9
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

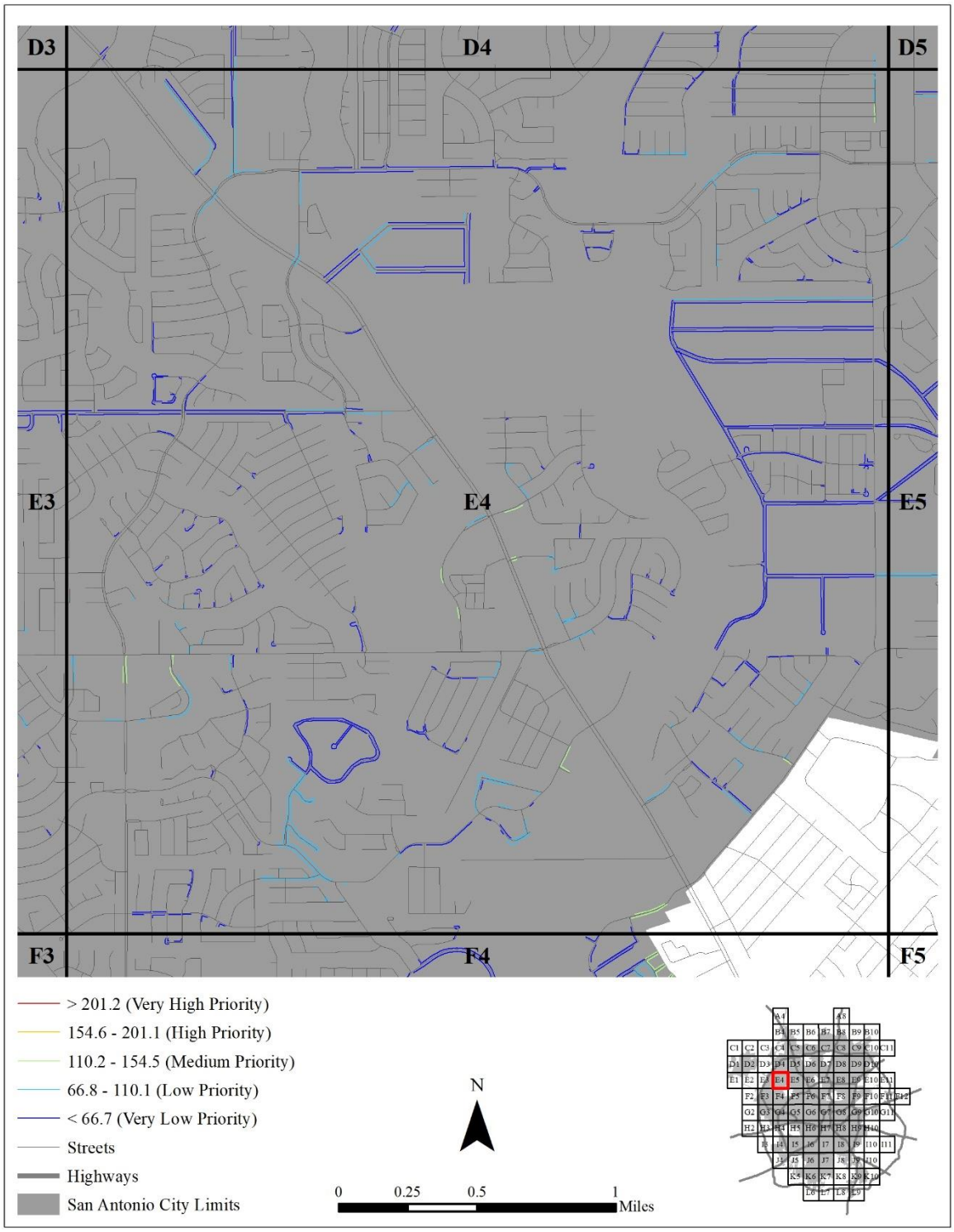

C8
C9
C10
D8
D9
D10
E8
E9
E10
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

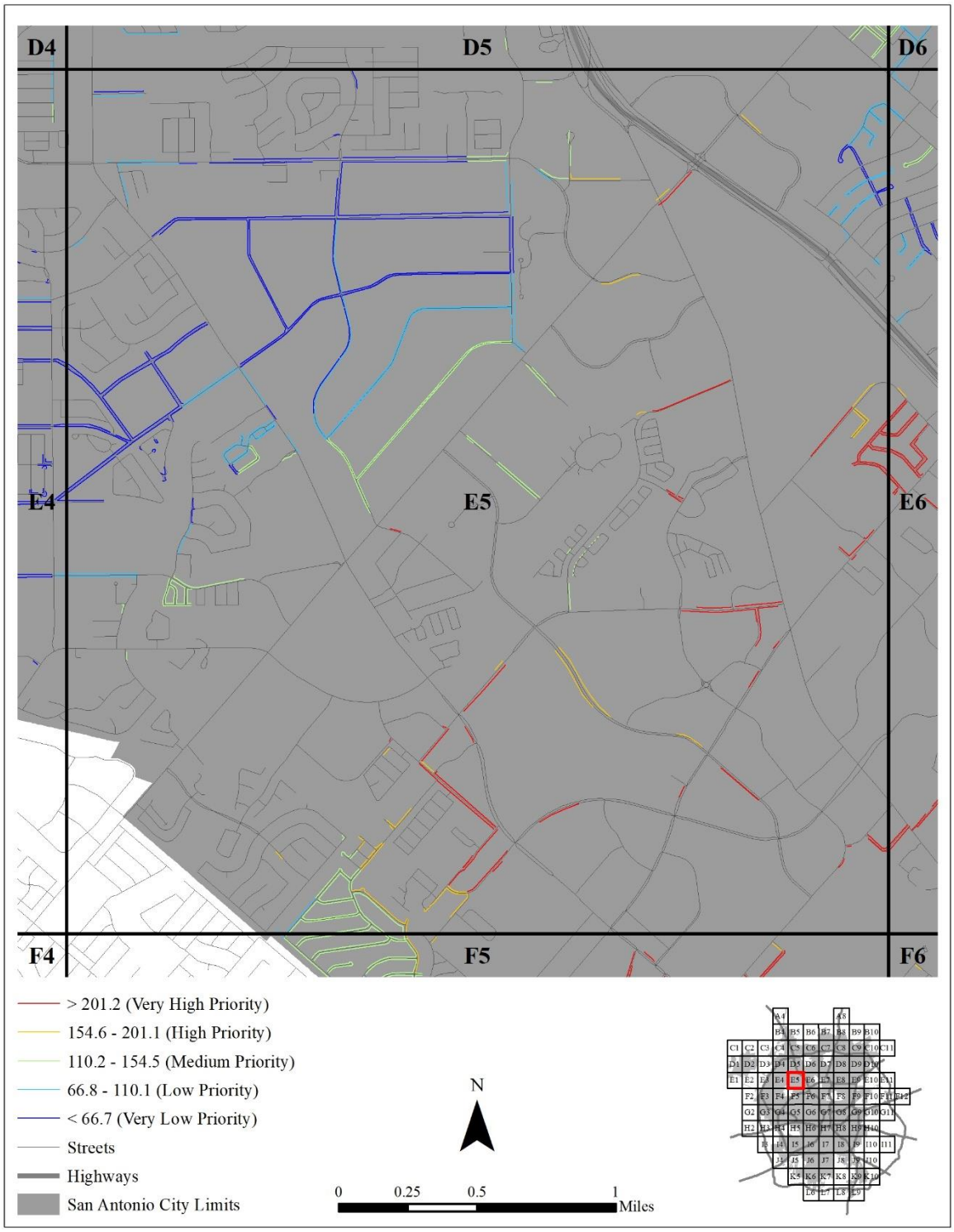

C9
C10
C11
D9
D10
E9
E10
E11
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

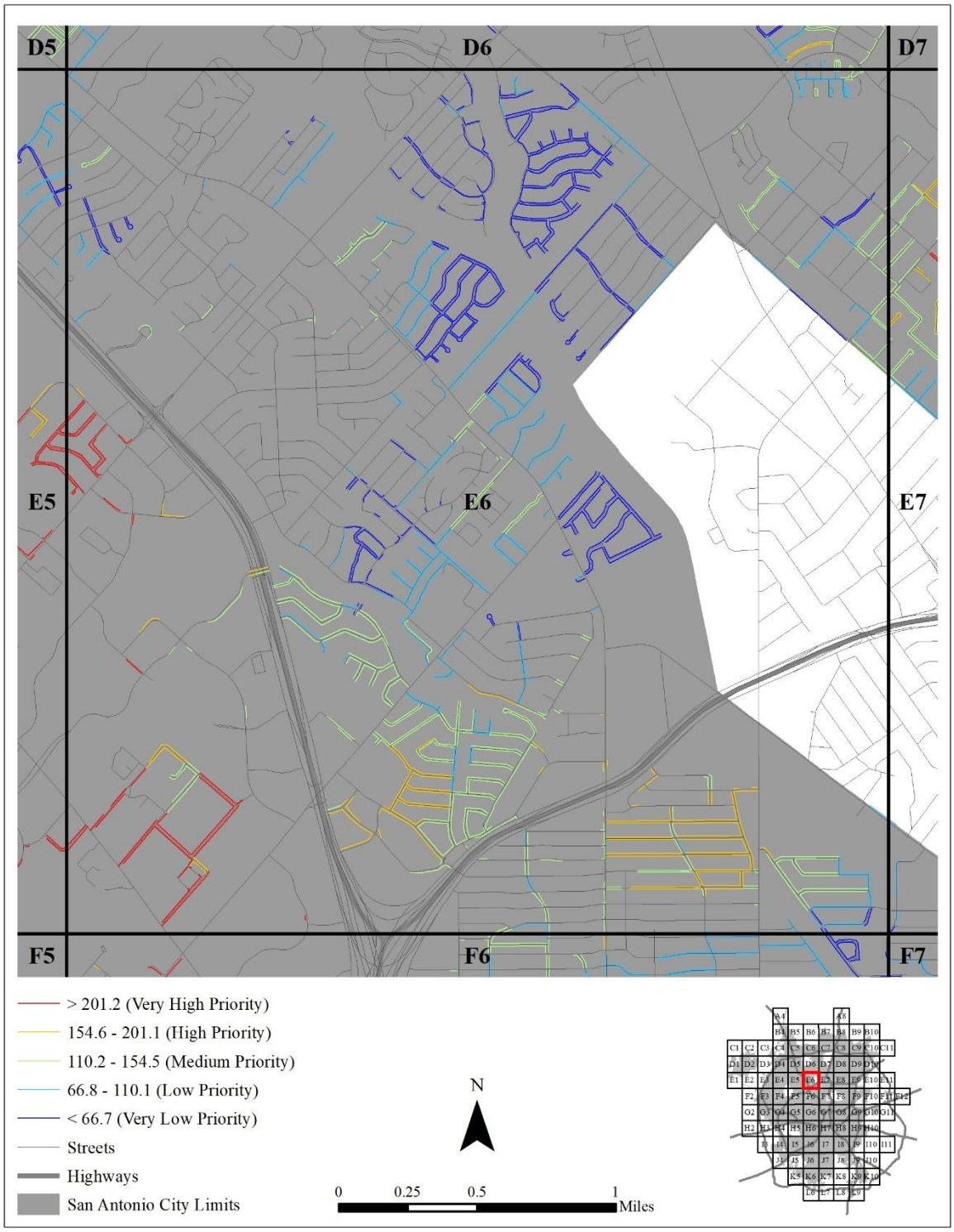

D1
D2
E1
E2
F2
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

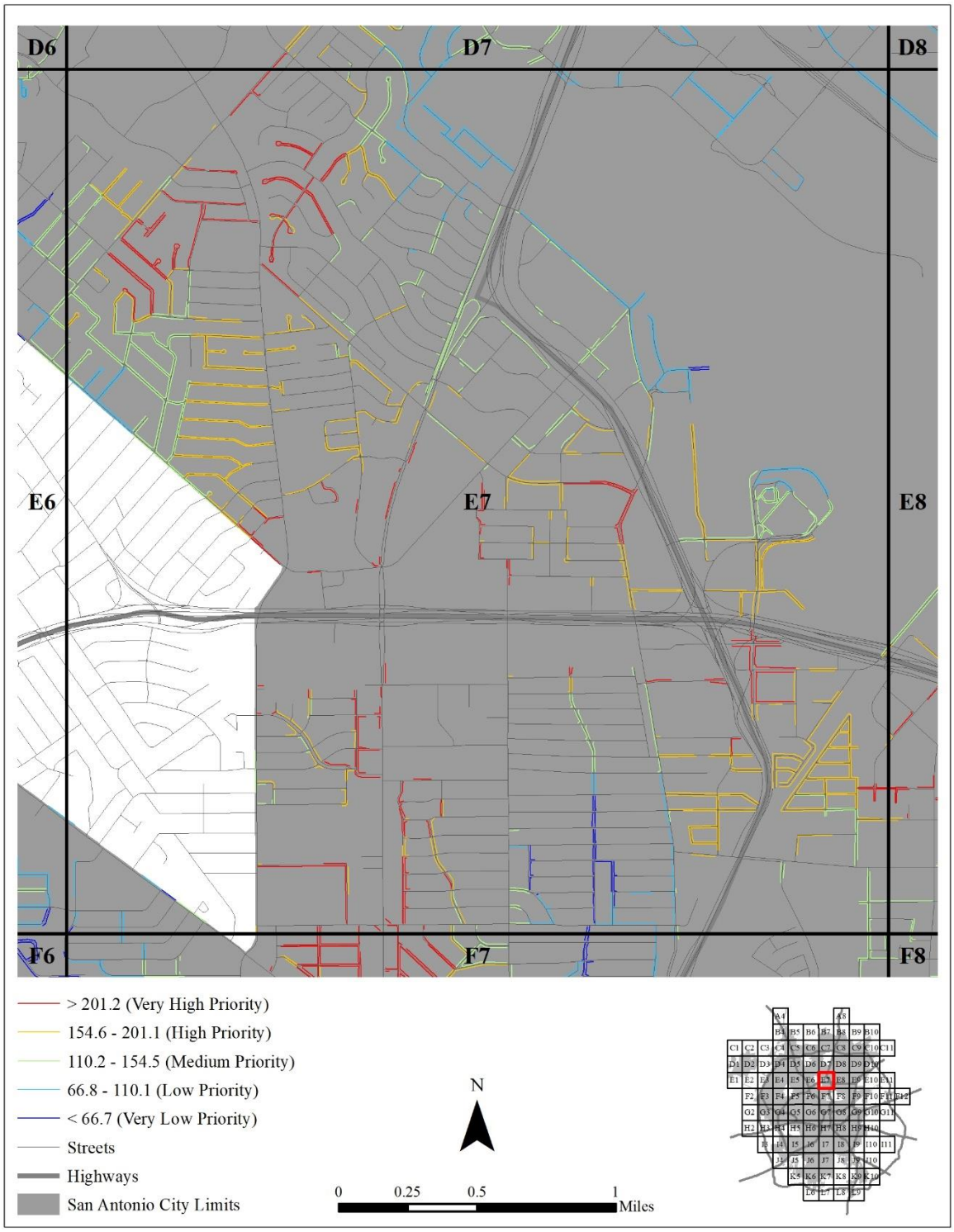

D1
D2
D3
E1
E2
E3
F2
F3
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

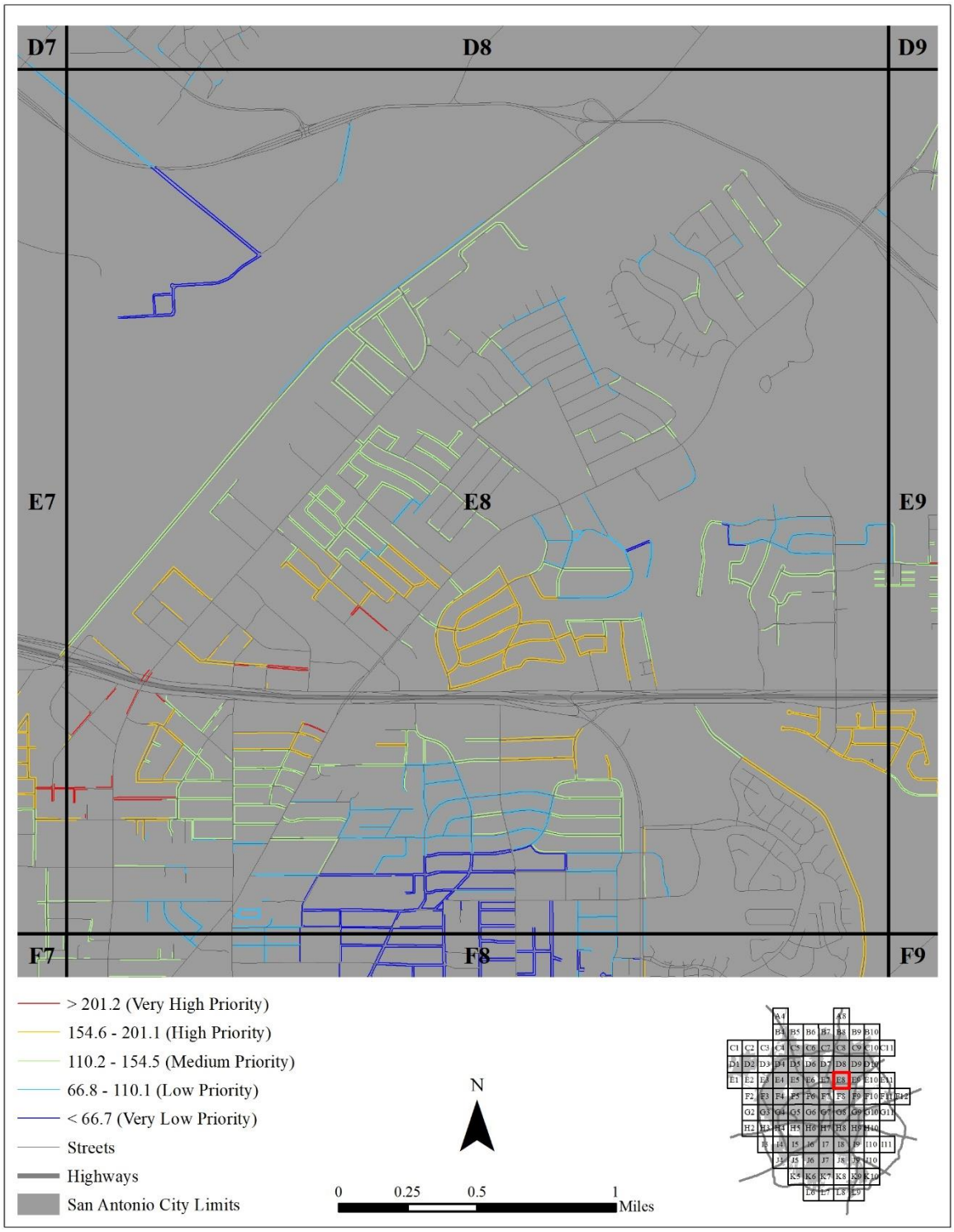

D2
D3
D4
E2
E3
E4
F2
F3
F4
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

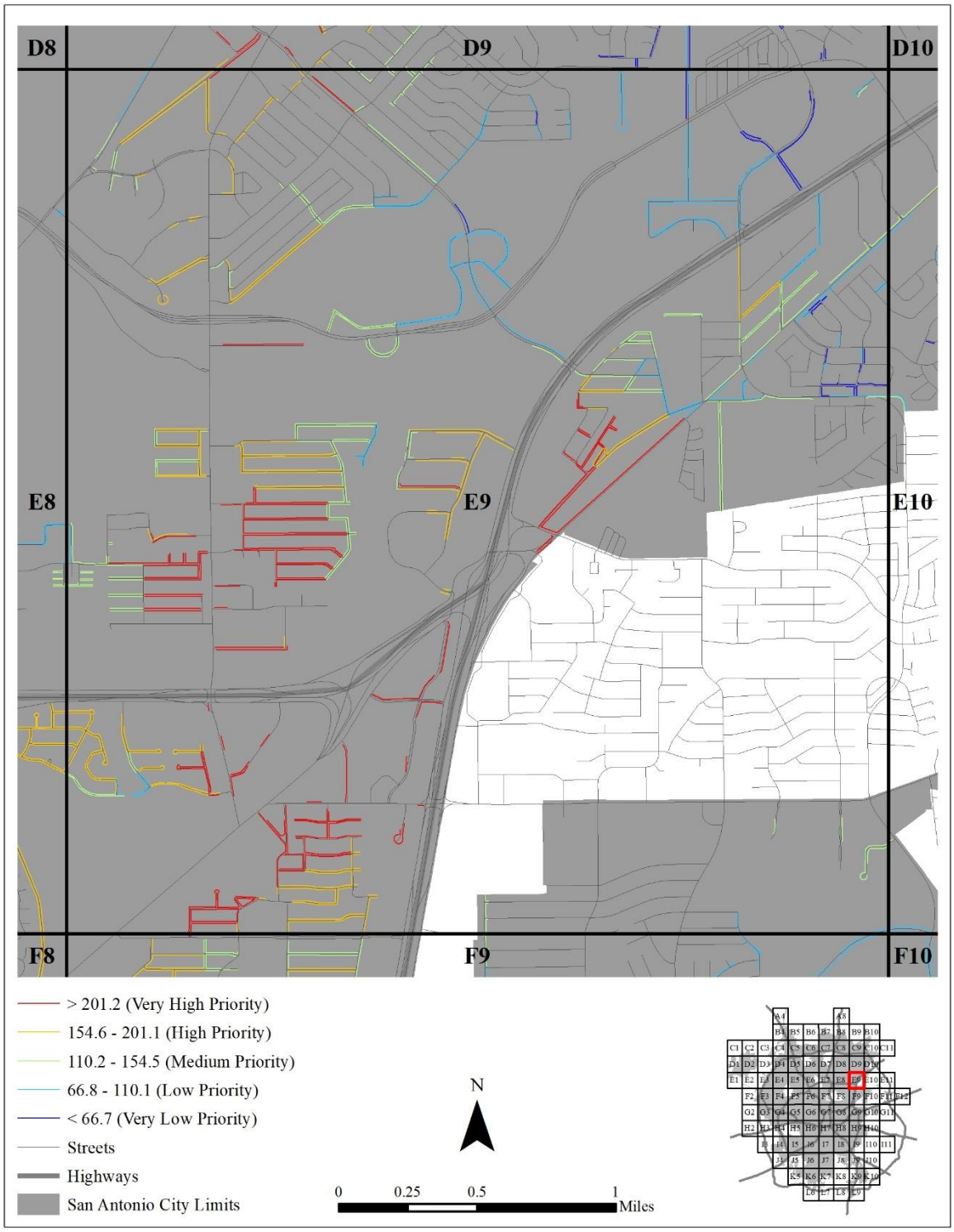

D3
D4
D5
E3
E4
E5
F3
F4
F5
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

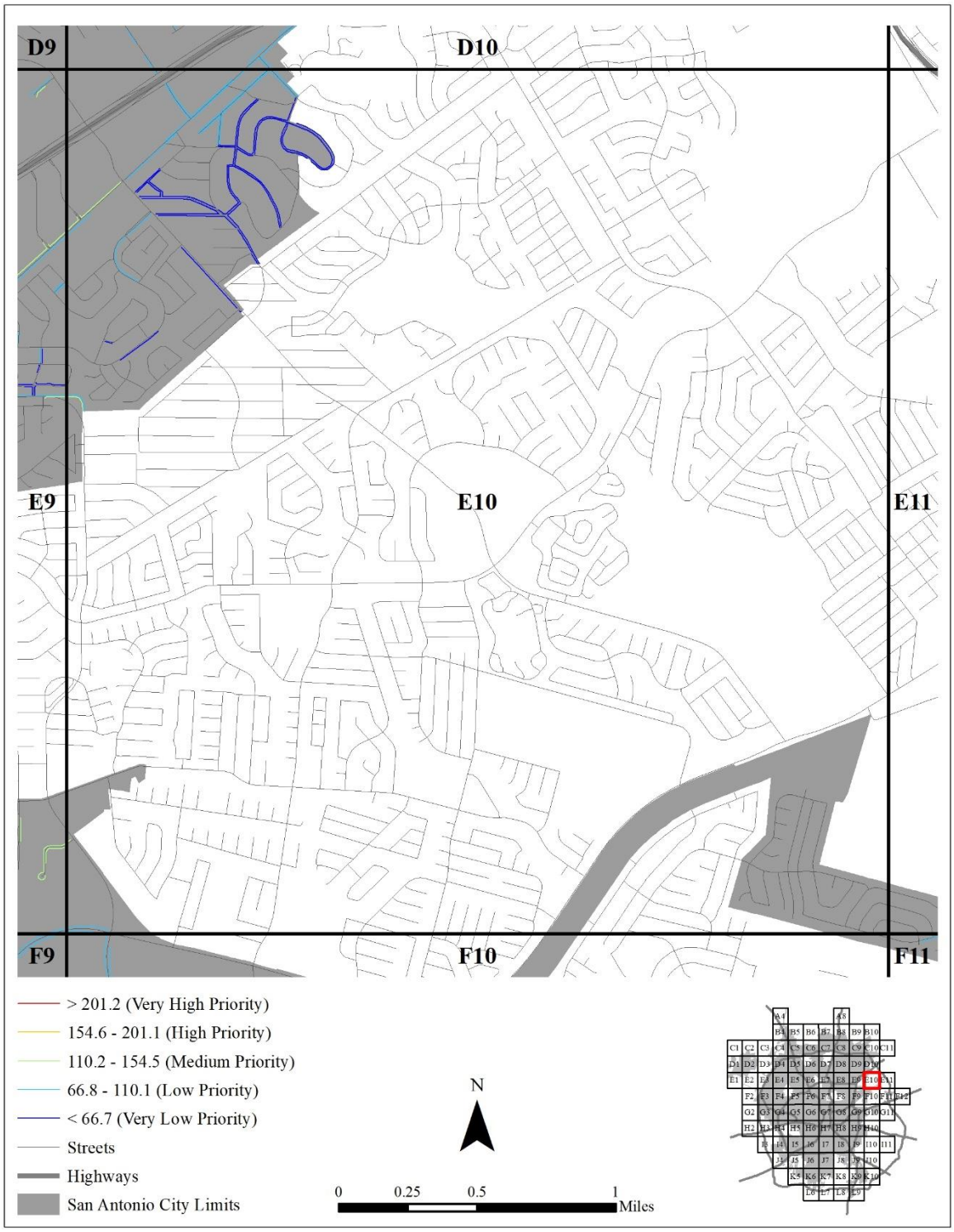

D4
D5
D6
E4
E5
E6
F4
F5
F6
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

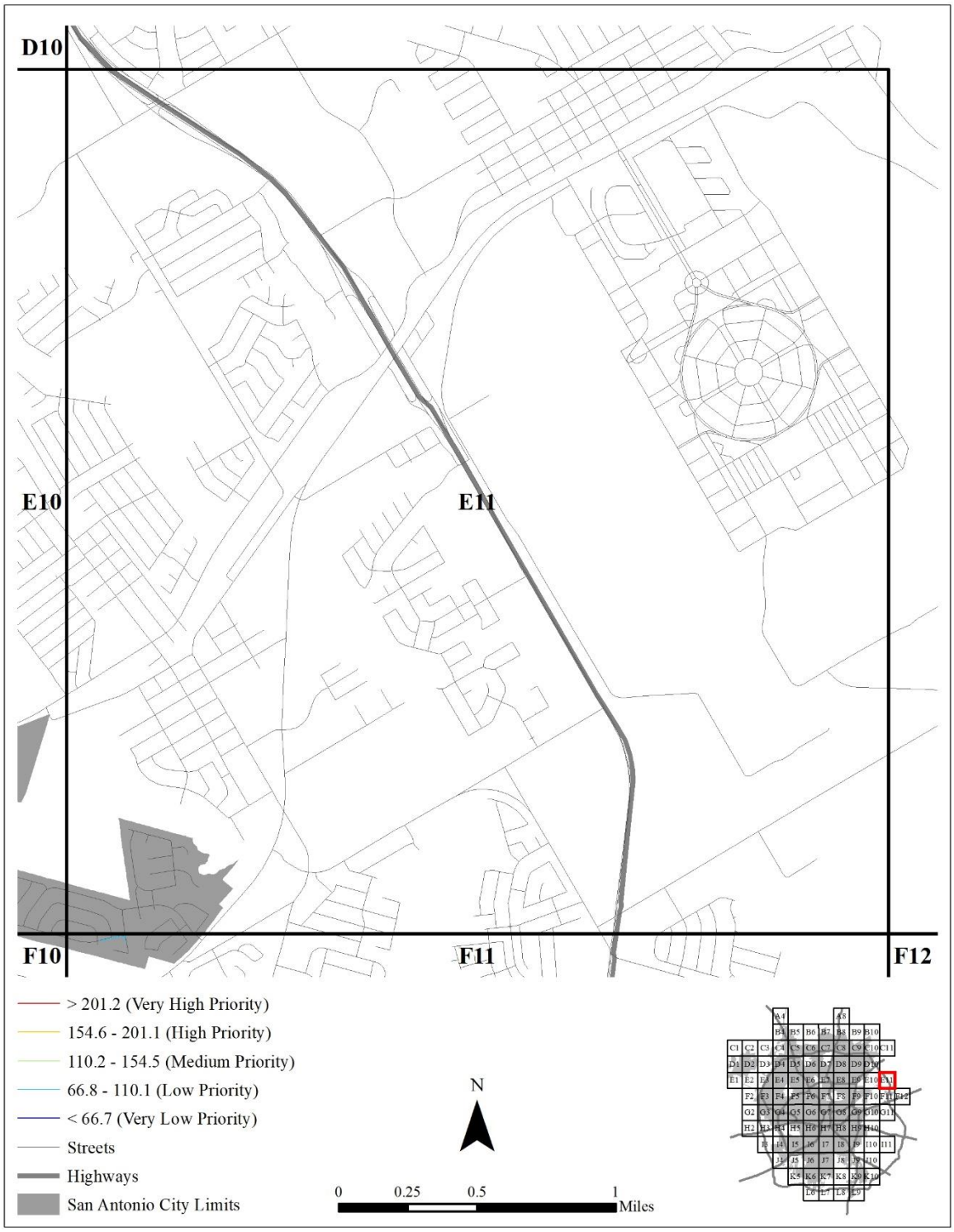

D5
D6
D7
E5
E6
E7
F5
F6
F7
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

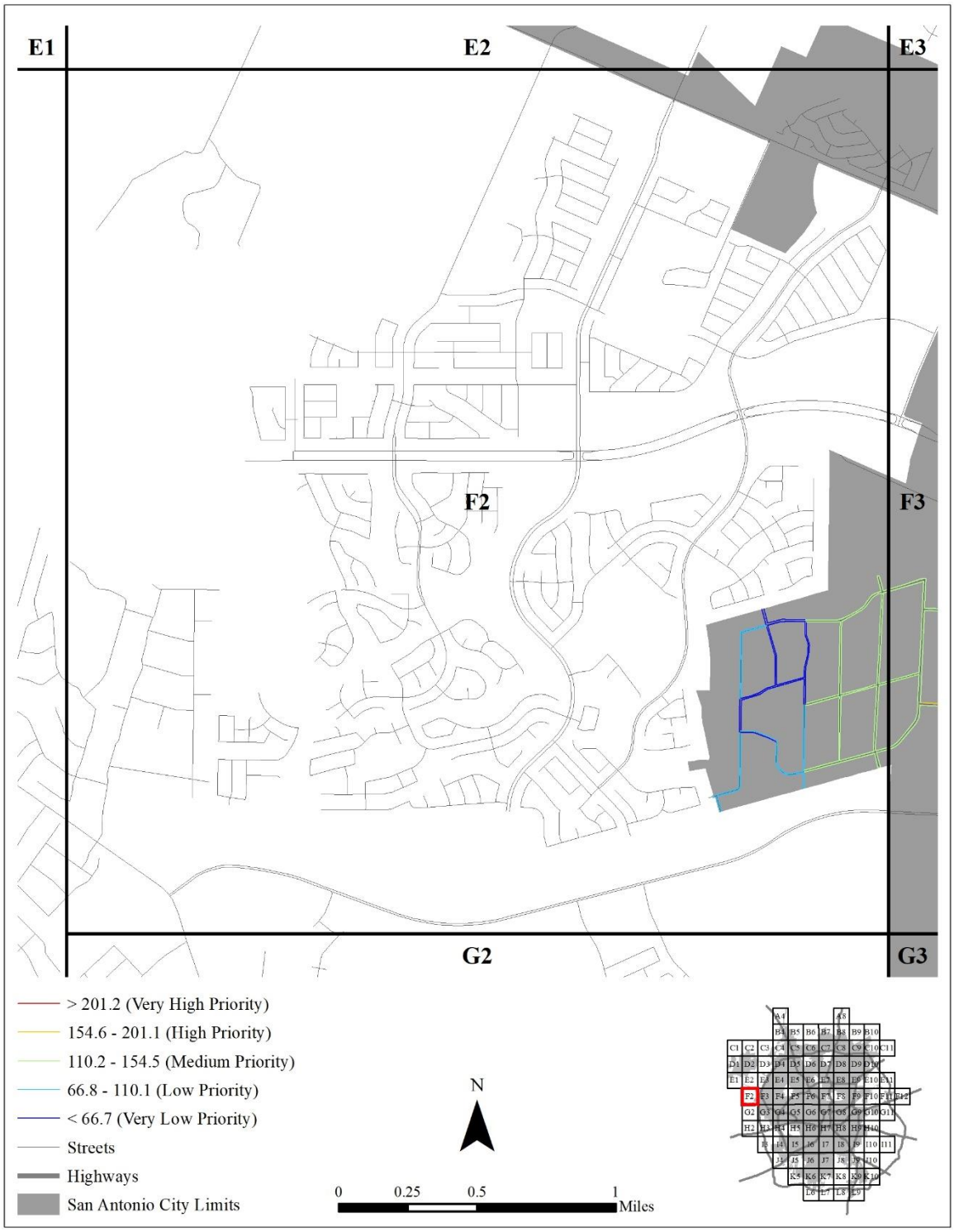

D6
D7
D8
E6
E7
E8
F6
F7
F8
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

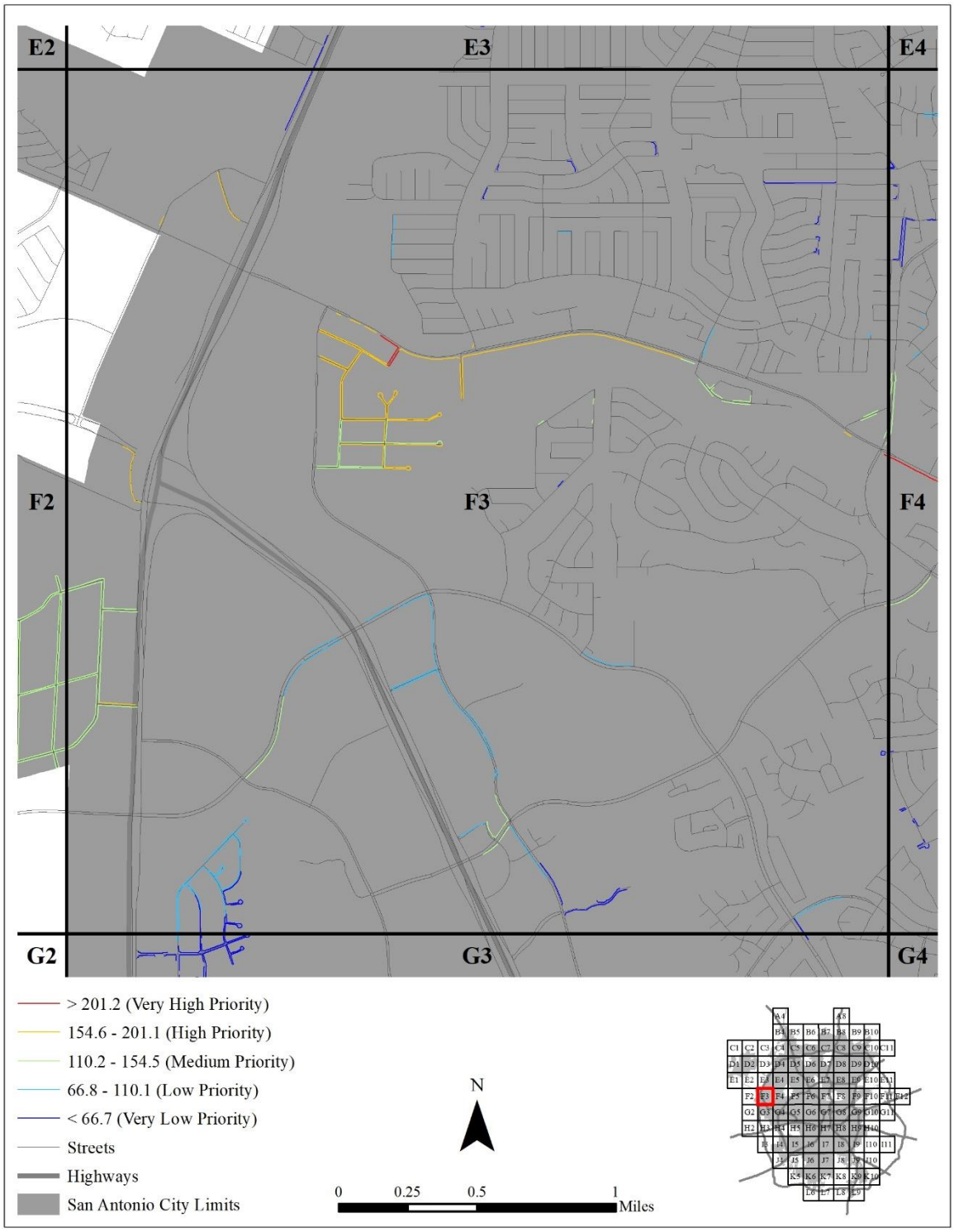

D7
D8
D9
E7
E8
E9
F7
F8
F9
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

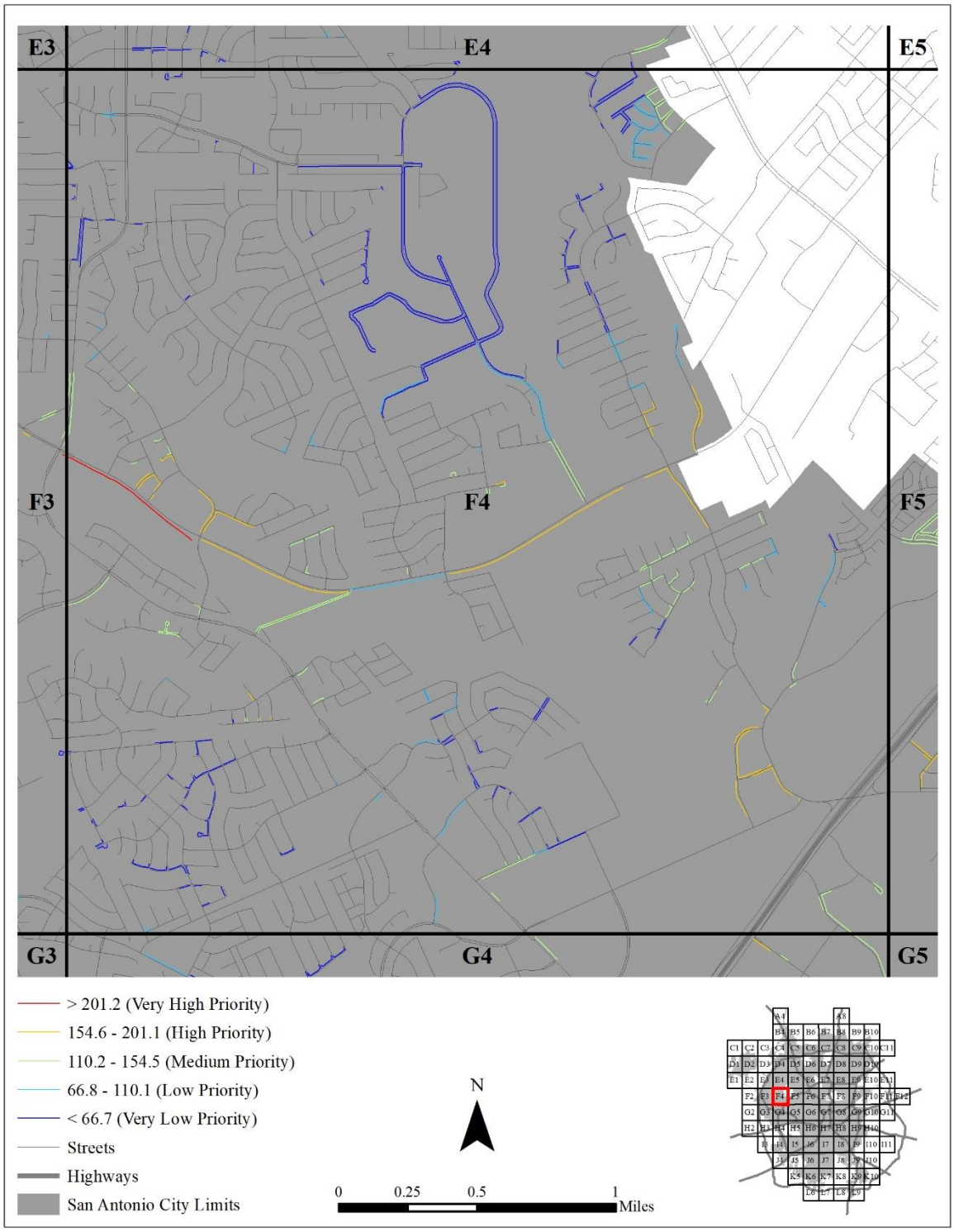

D8
D9
D10
E8
E9
E10
F8
F9
F10
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

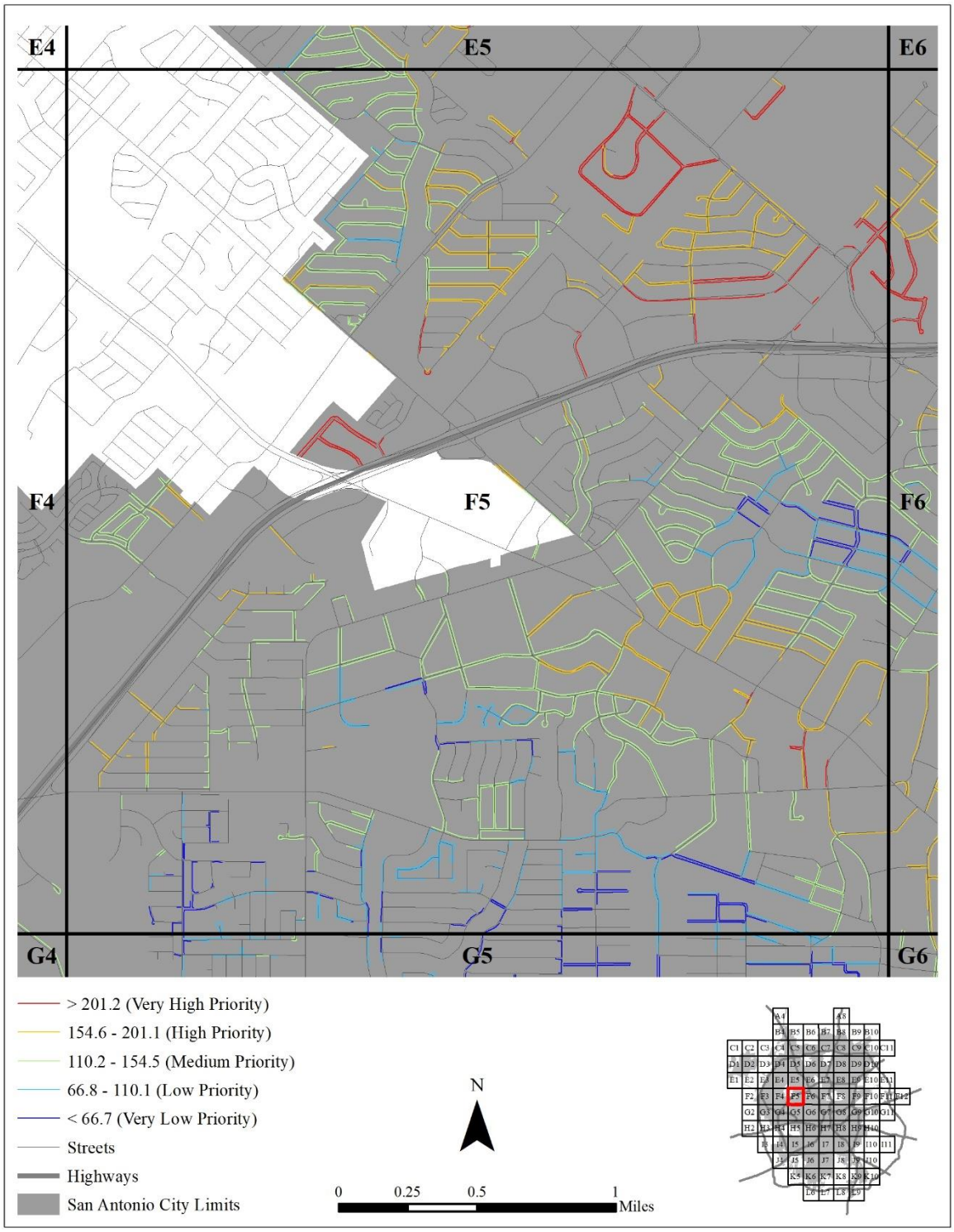

D9
D10
E9
E10
E11
F9
F10
F11
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

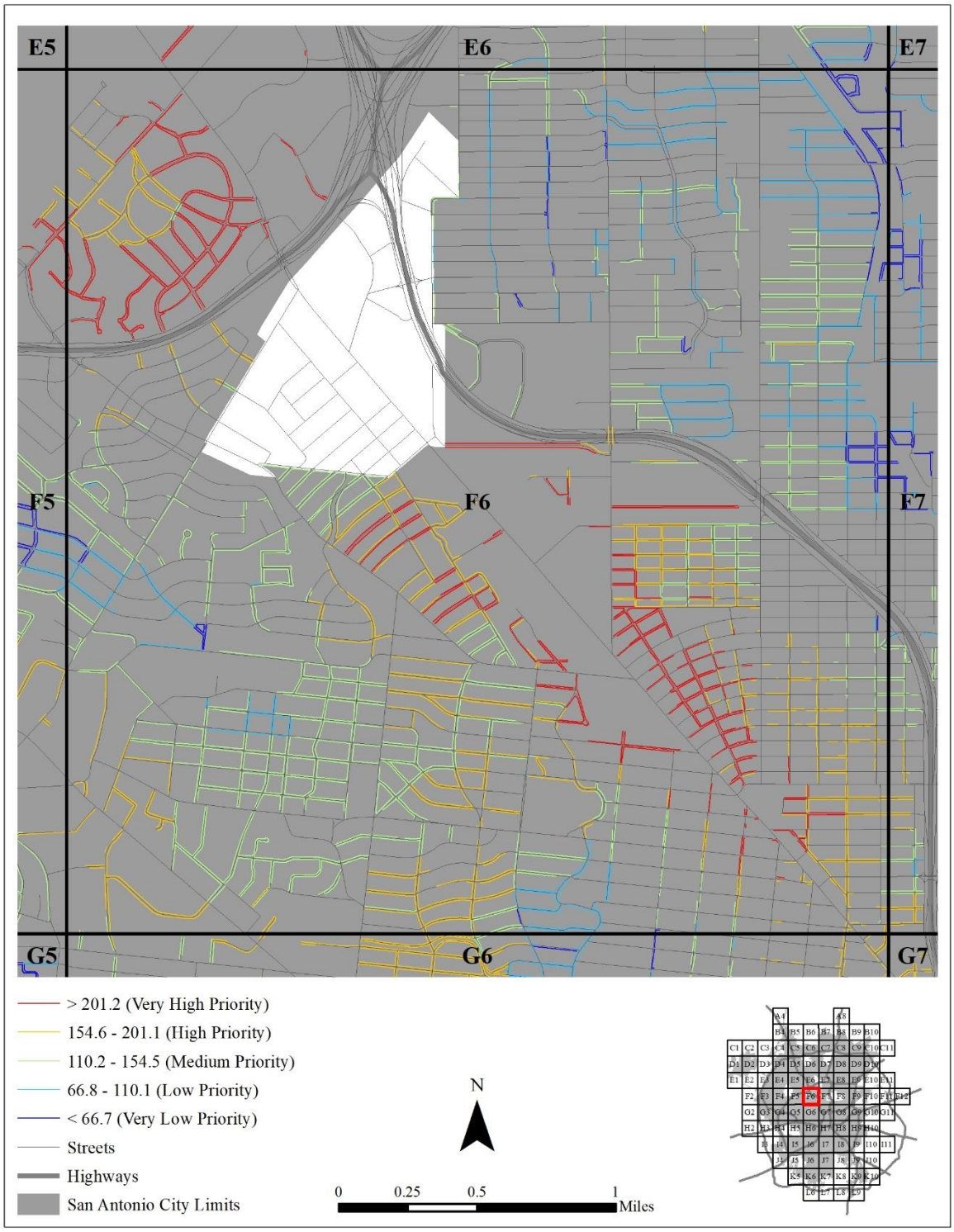

D10
E10
E11
F10
F11
F12
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

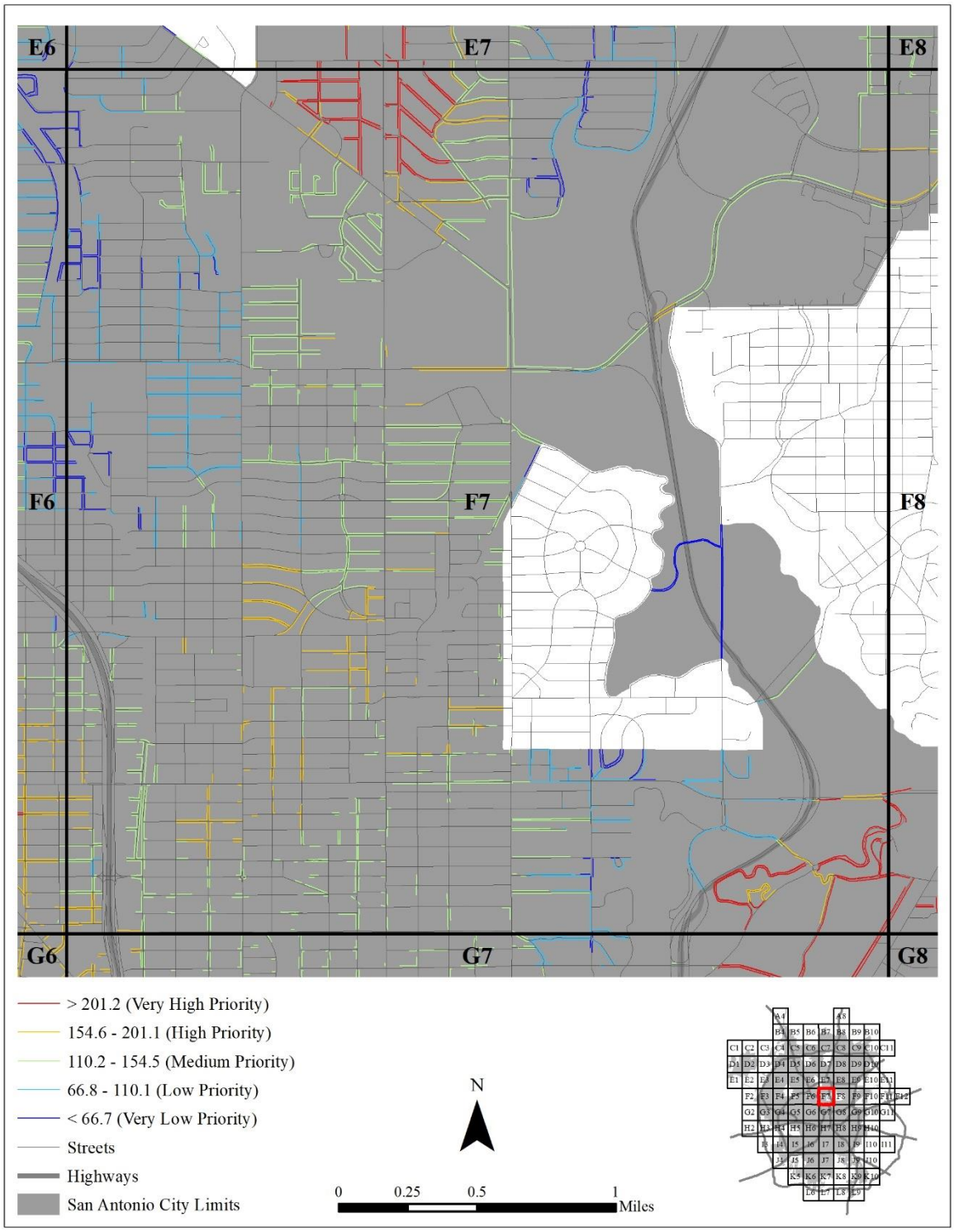

E1
E2
E3
F2
F3
G2
G3
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

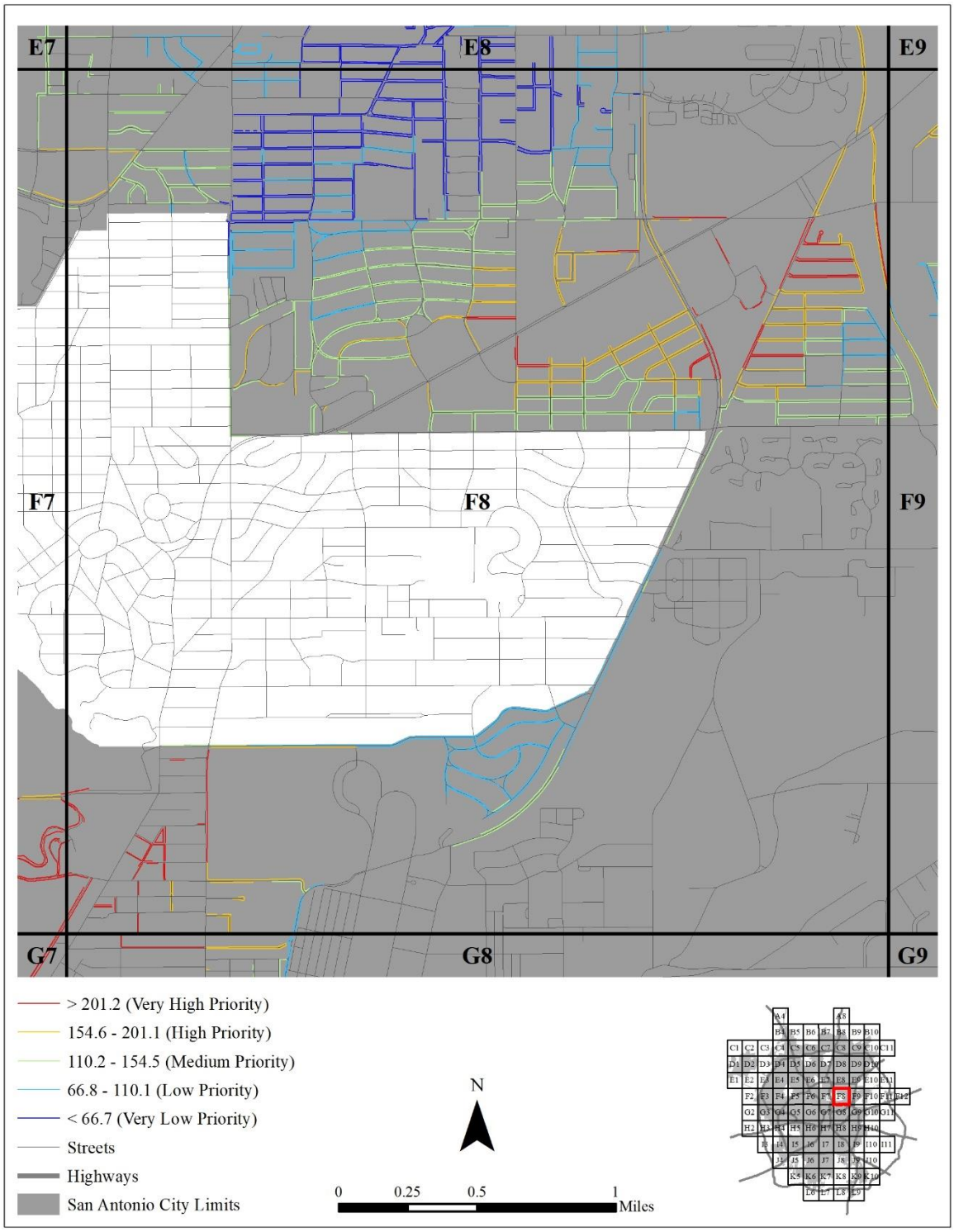

E2
E3
E4
F2
F3
F4
G2
G3
G4
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

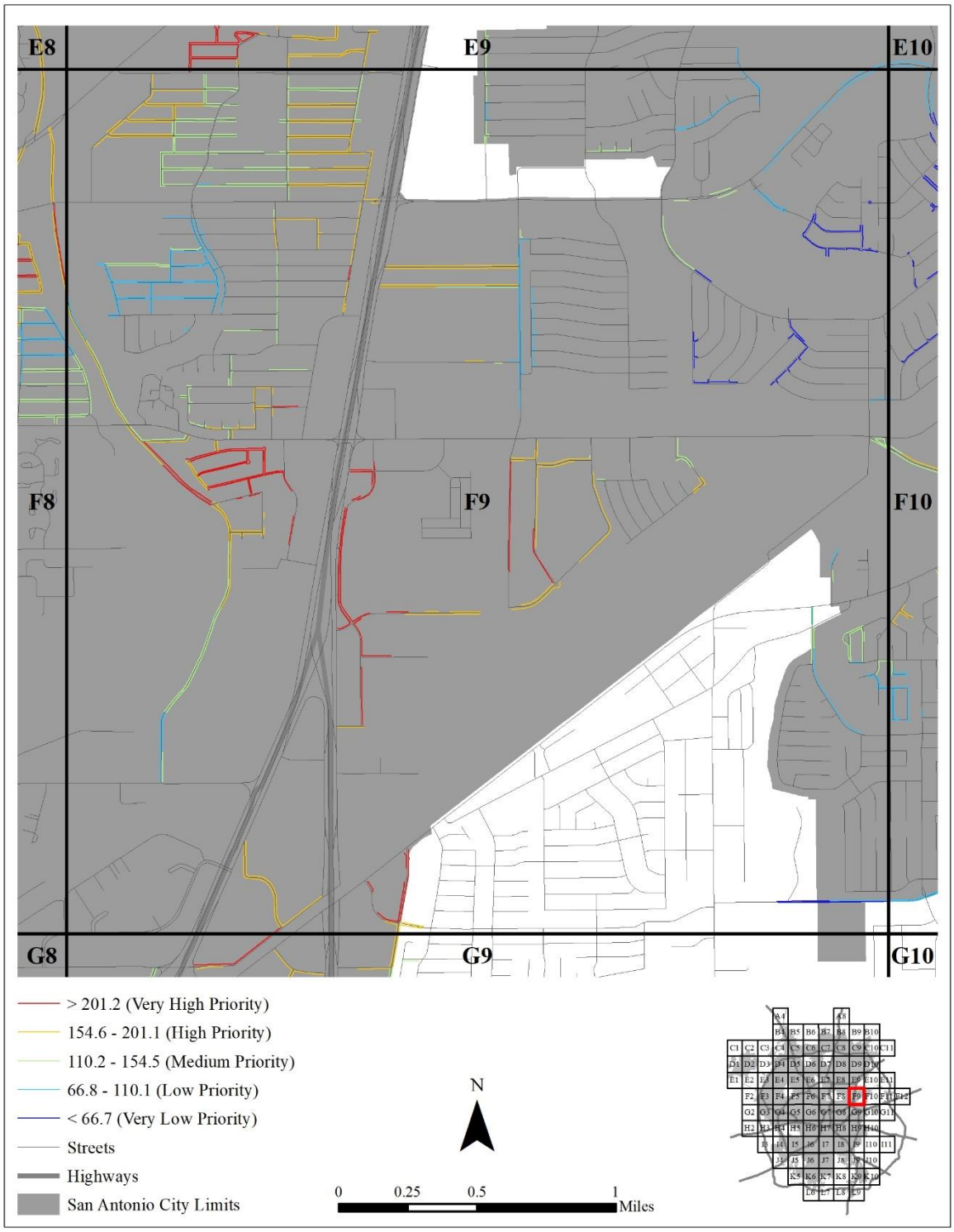

E3
E4
E5
F3
F4
F5
G3
G4
G5
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

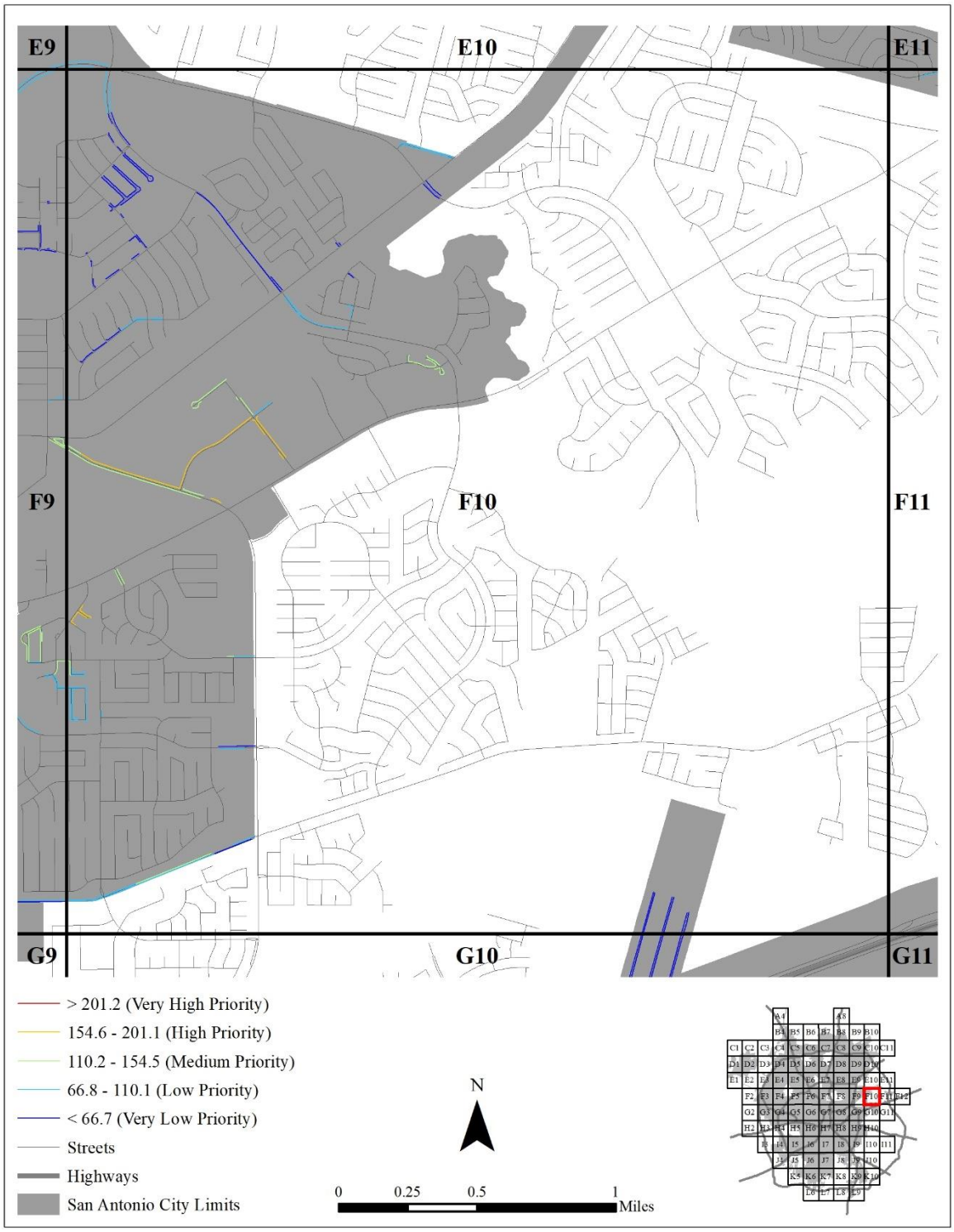

E4
E5
E6
F4
F5
F6
G4
G5
G6
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

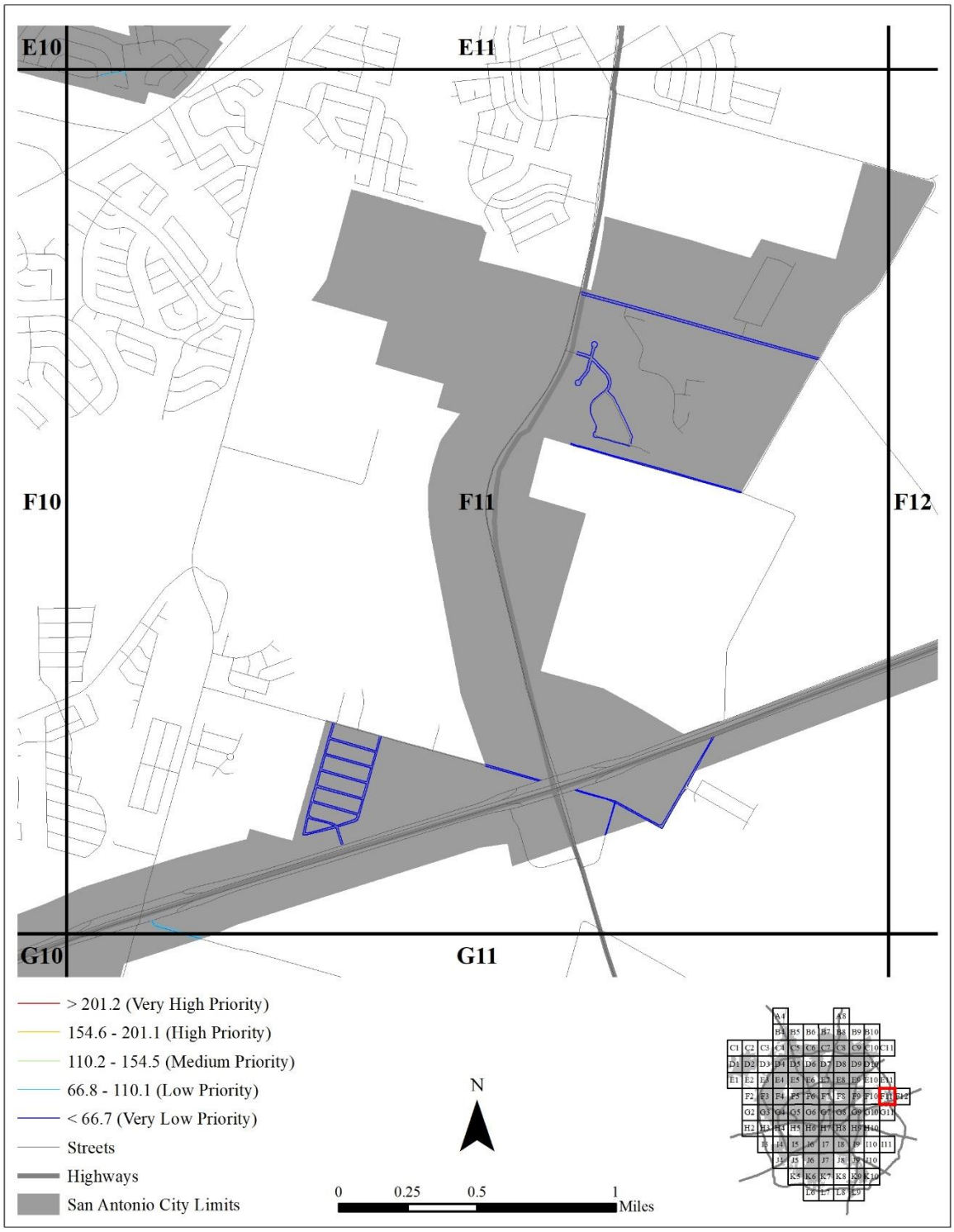

E5
E6
E7
F5
F6
F7
G5
G6
G7
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

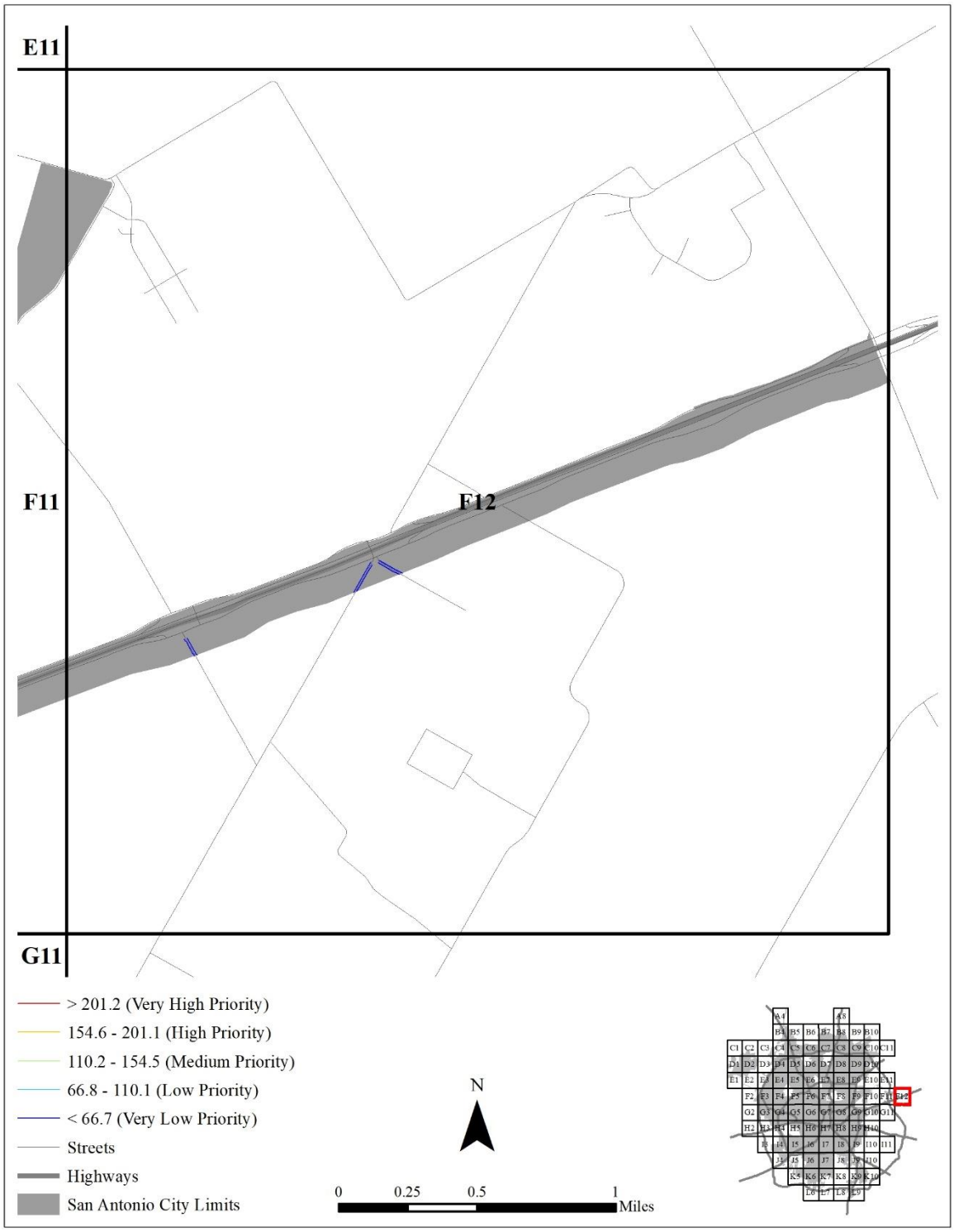

E6
E7
E8
F6
F7
F8
G6
G7
G8
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

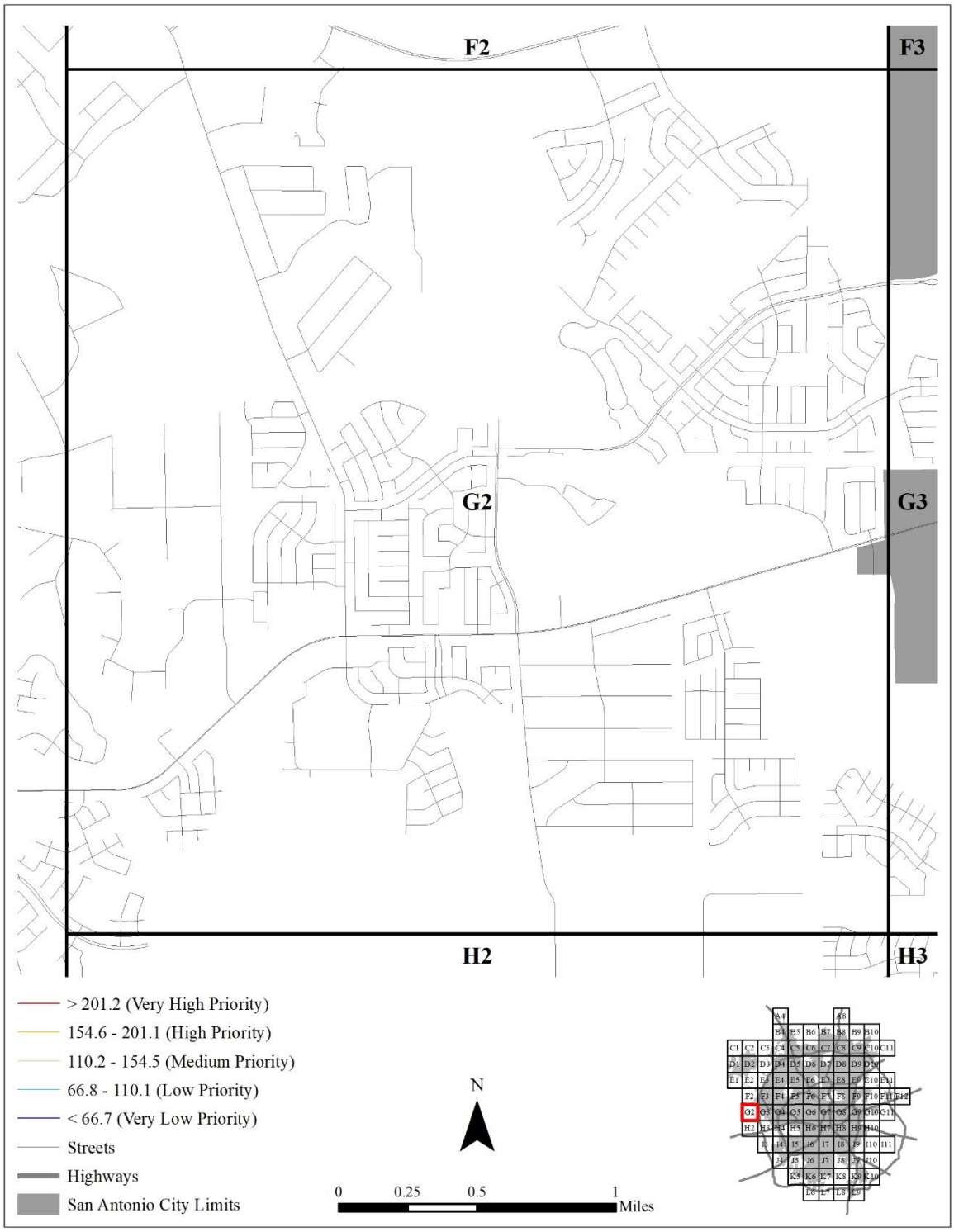

E7
E8
E9
F7
F8
F9
G7
G8
G9
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

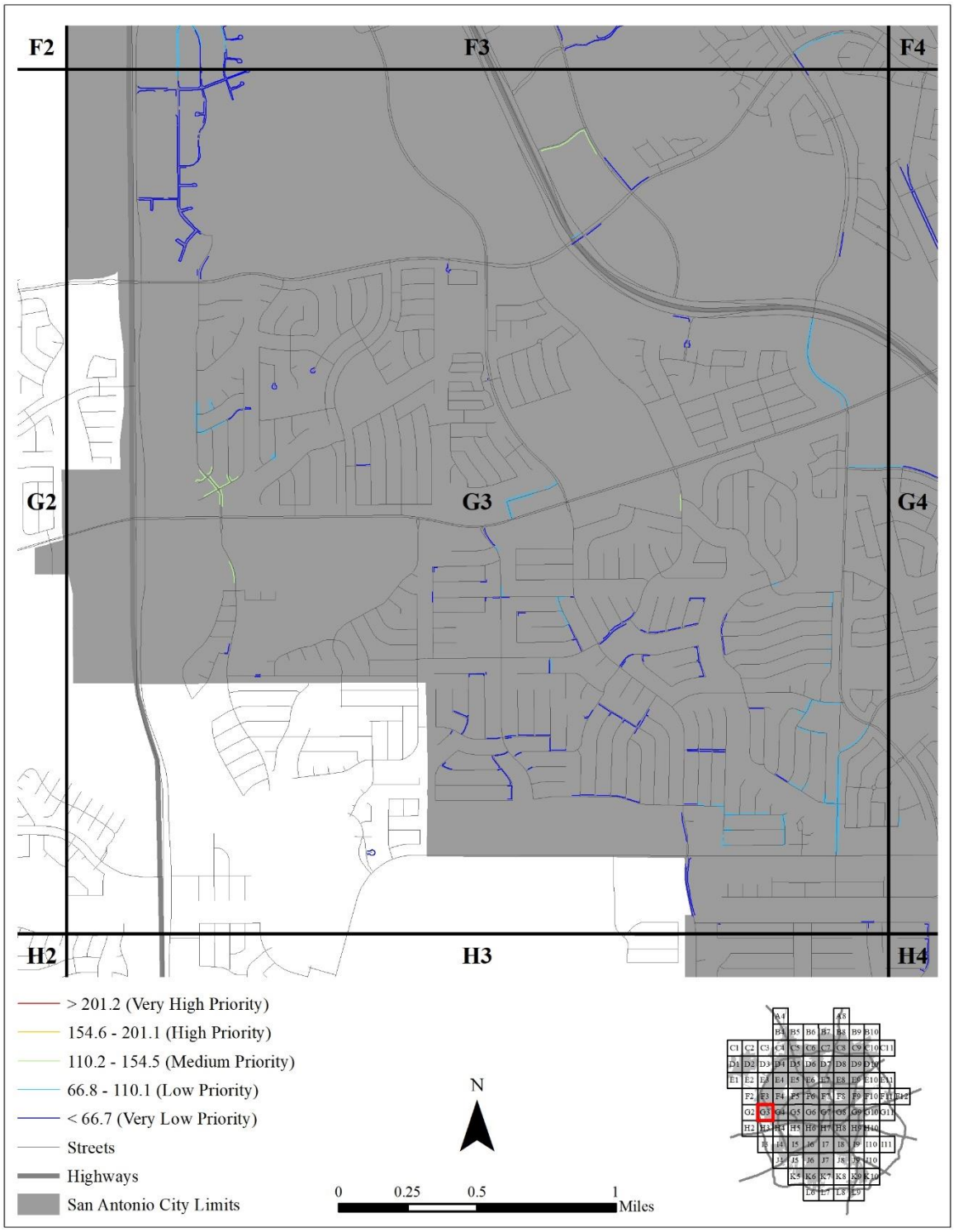

E8
E9
E10
F8
F9
F10
G8
G9
G10
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

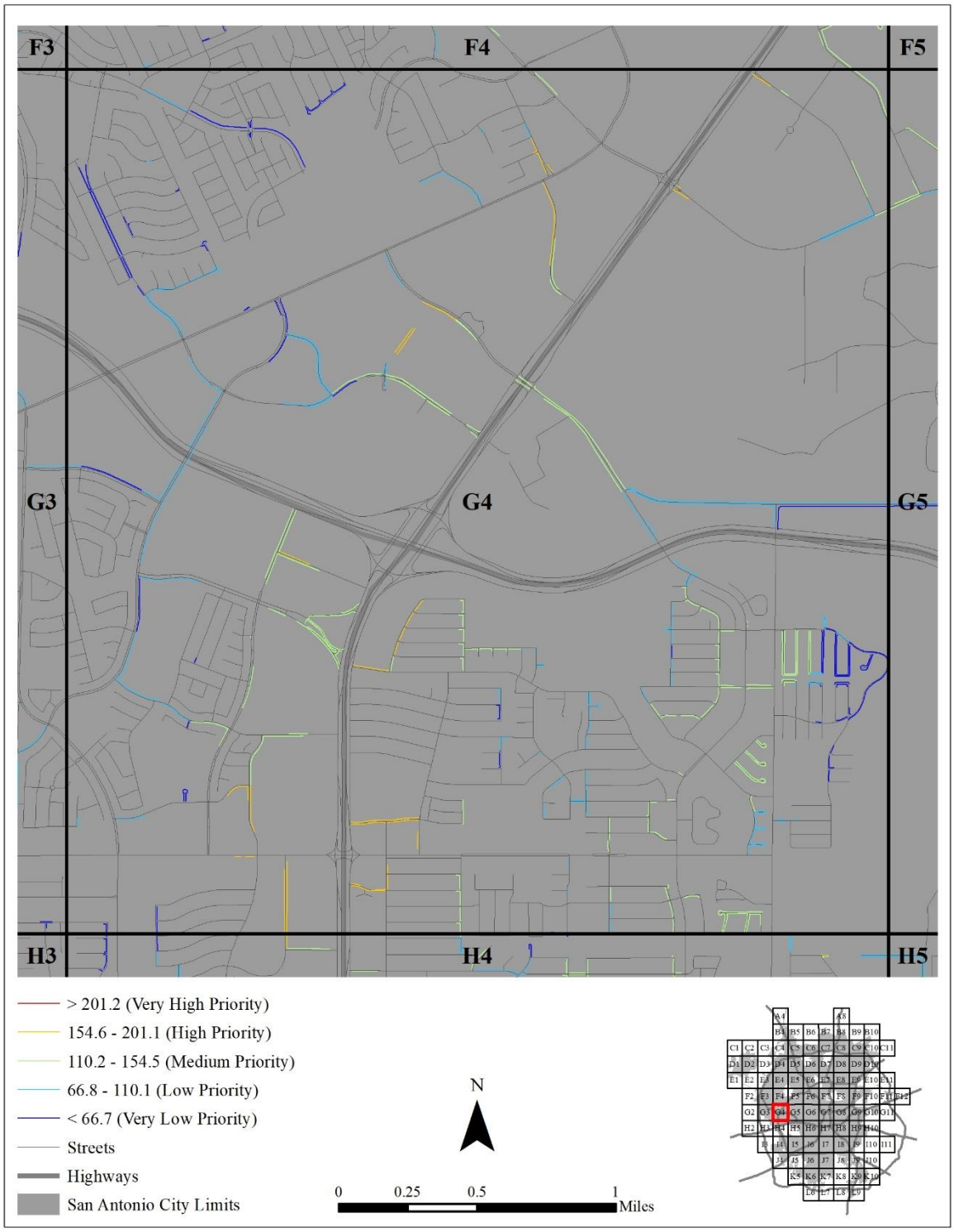

E9
E10
E11
F9
F10
F11
G9
G10
G11
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

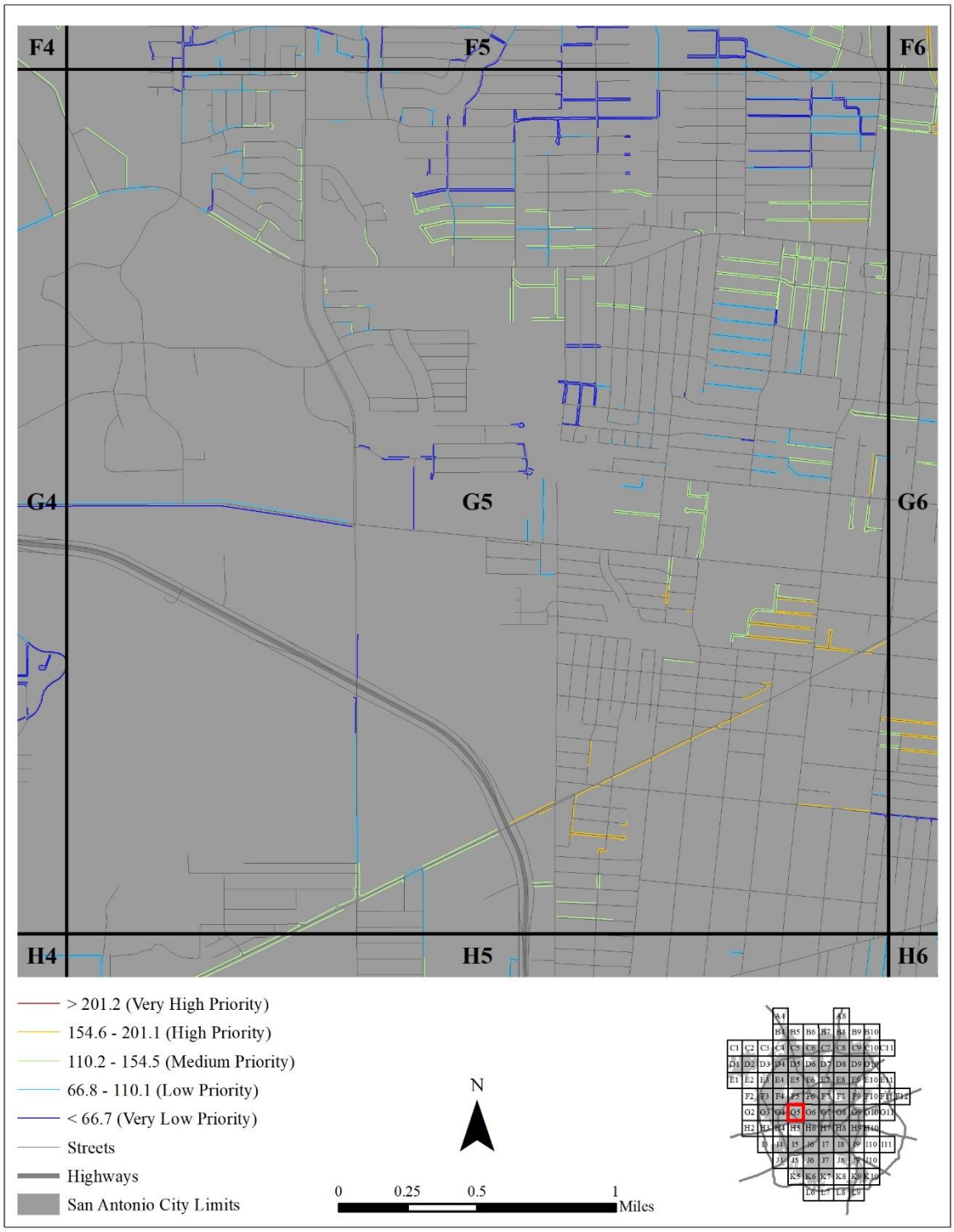

E10
E11
F10
F11
F12
G10
G11
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

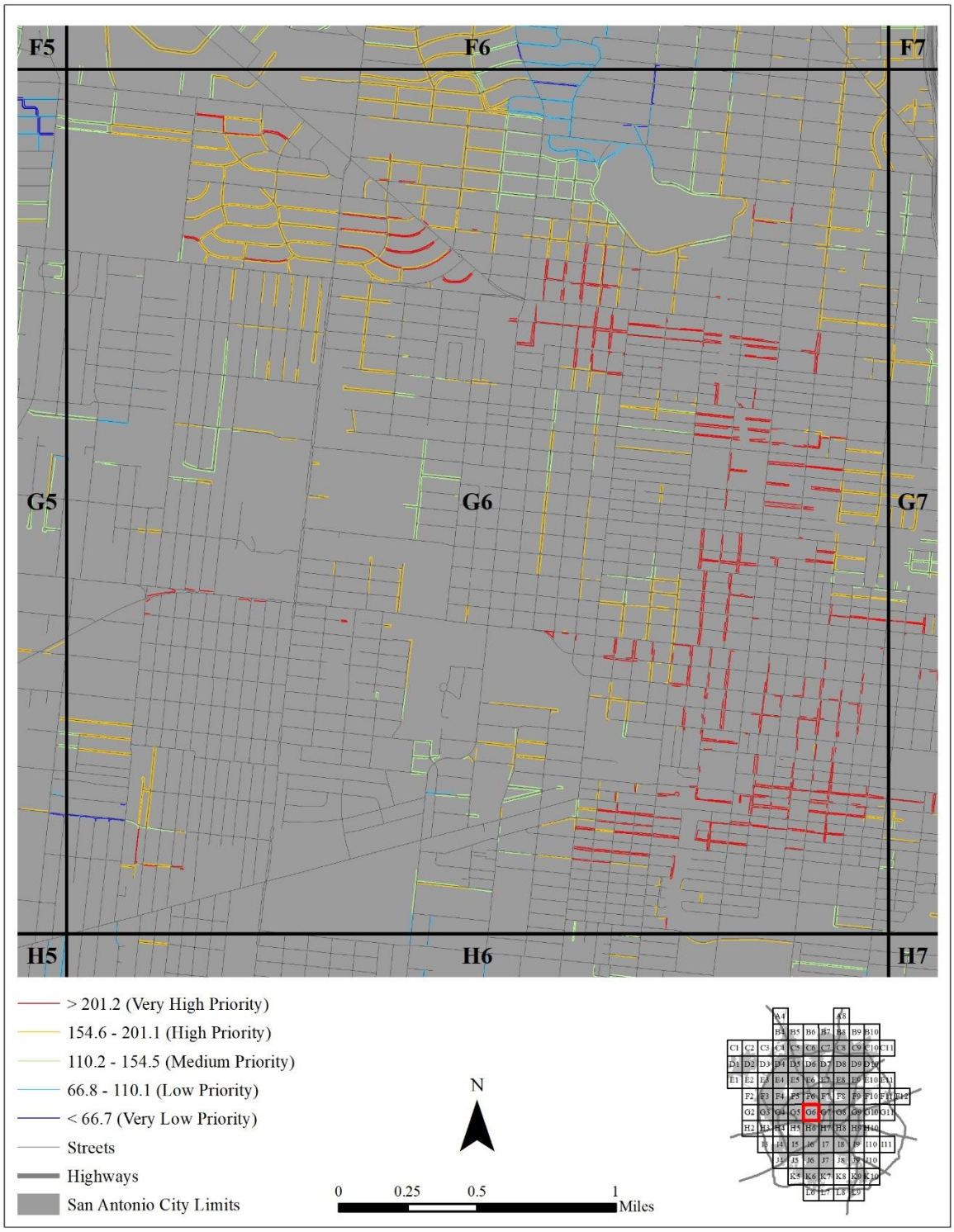

E11
F11
F12
G11
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

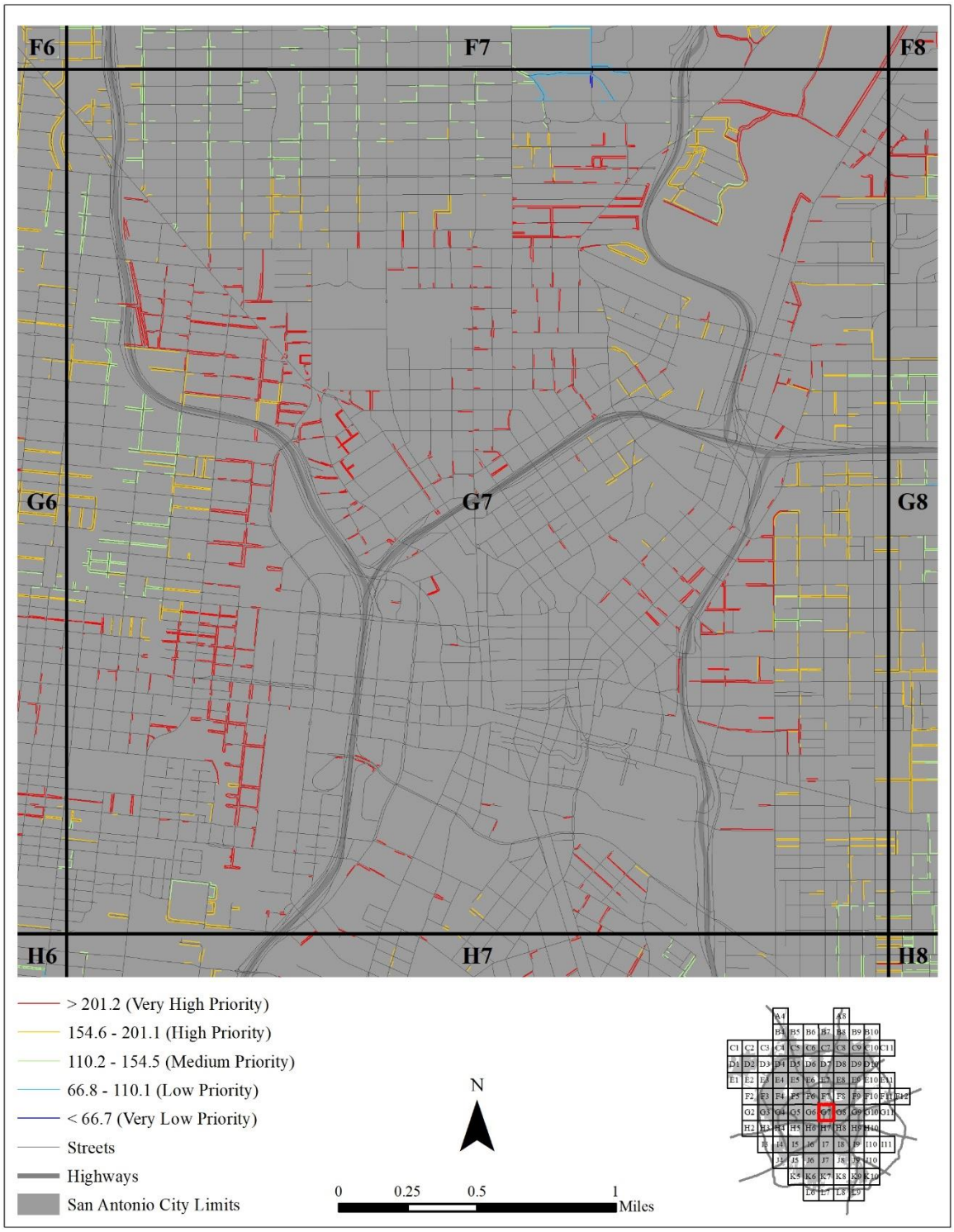

F2
F3
G2
G3
H2
H3
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

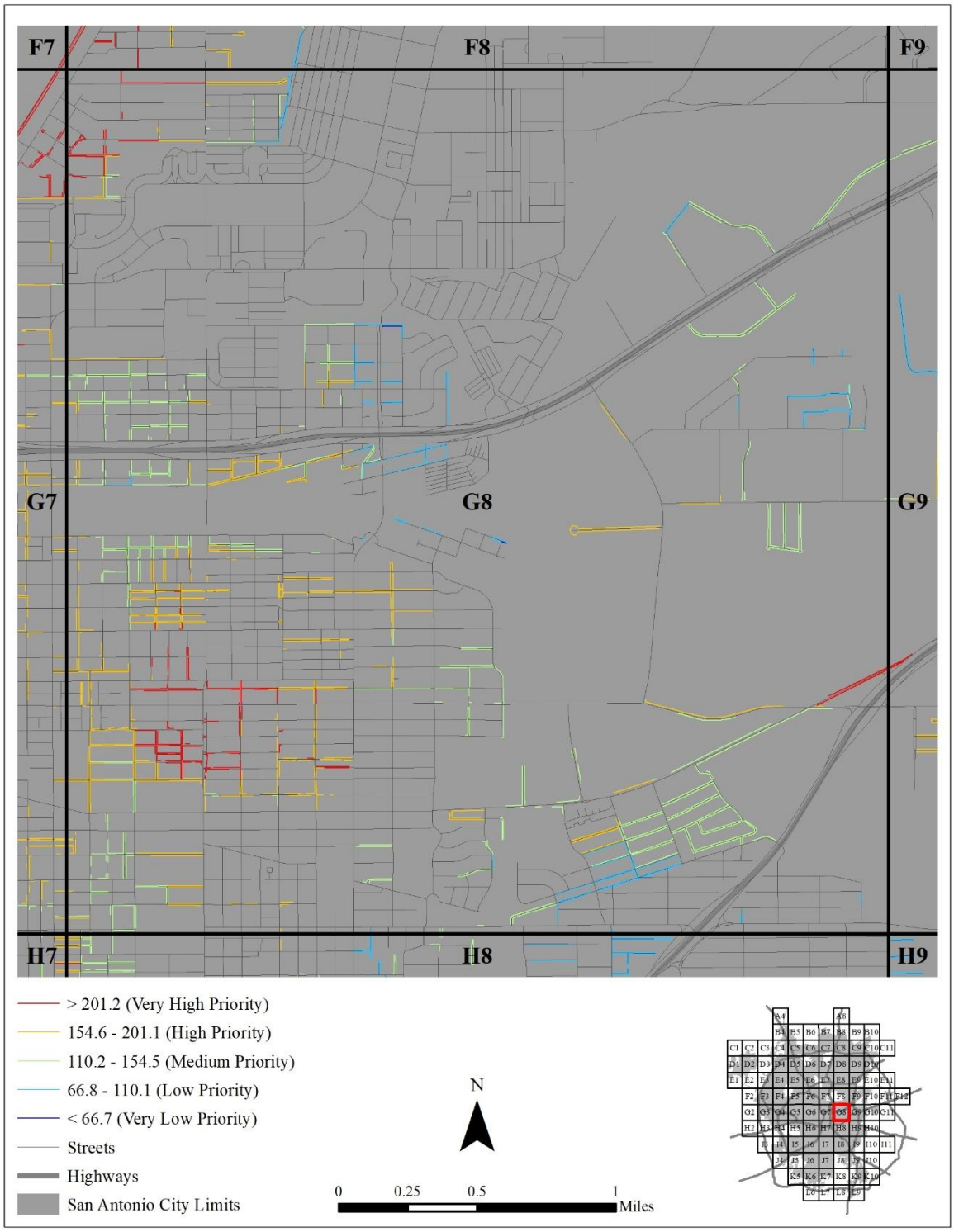

F2
F3
F4
G2
G3
G4
H2
H3
H4
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

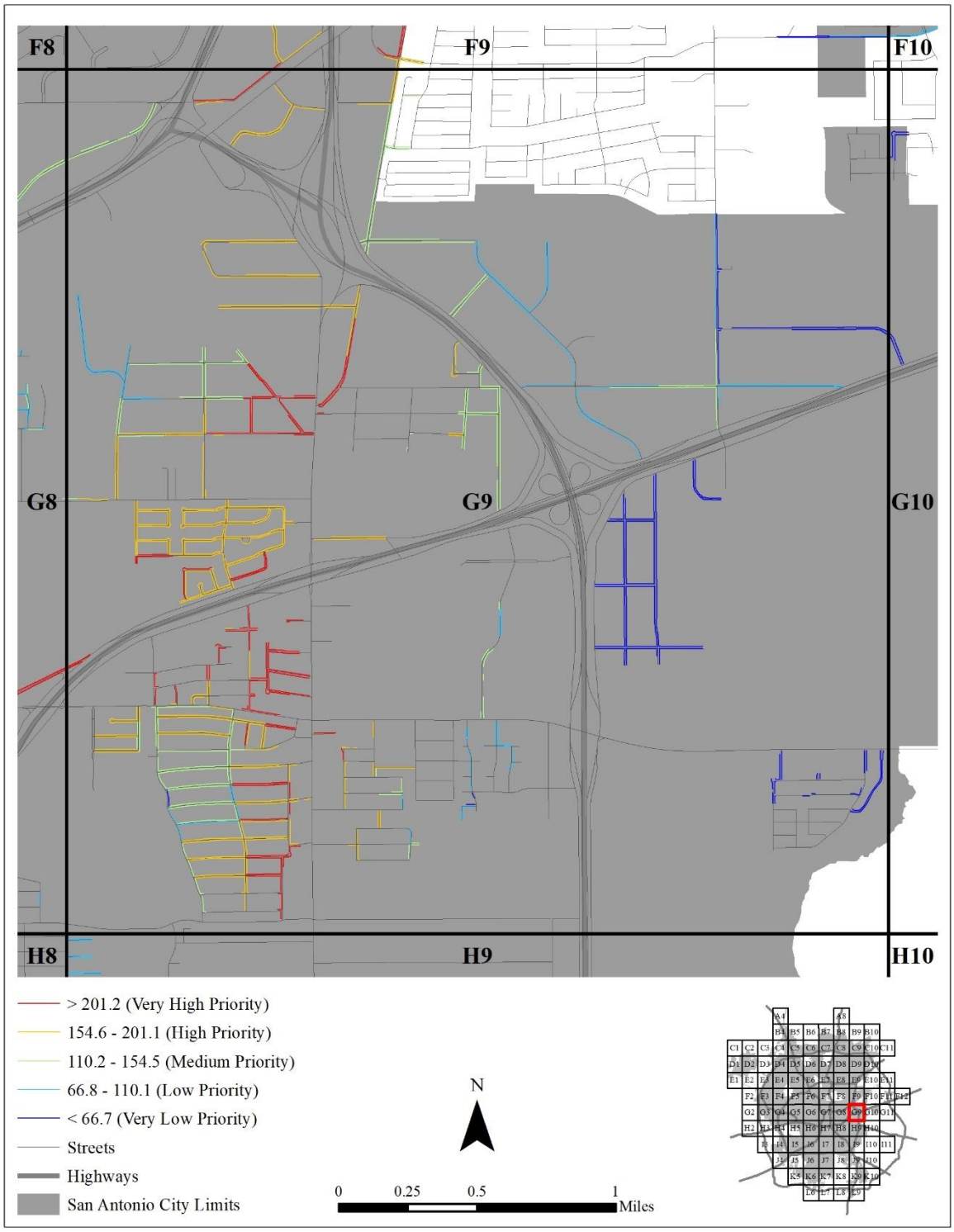

F3
F4
F5
G3
G4
G5
H3
H4
H5
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

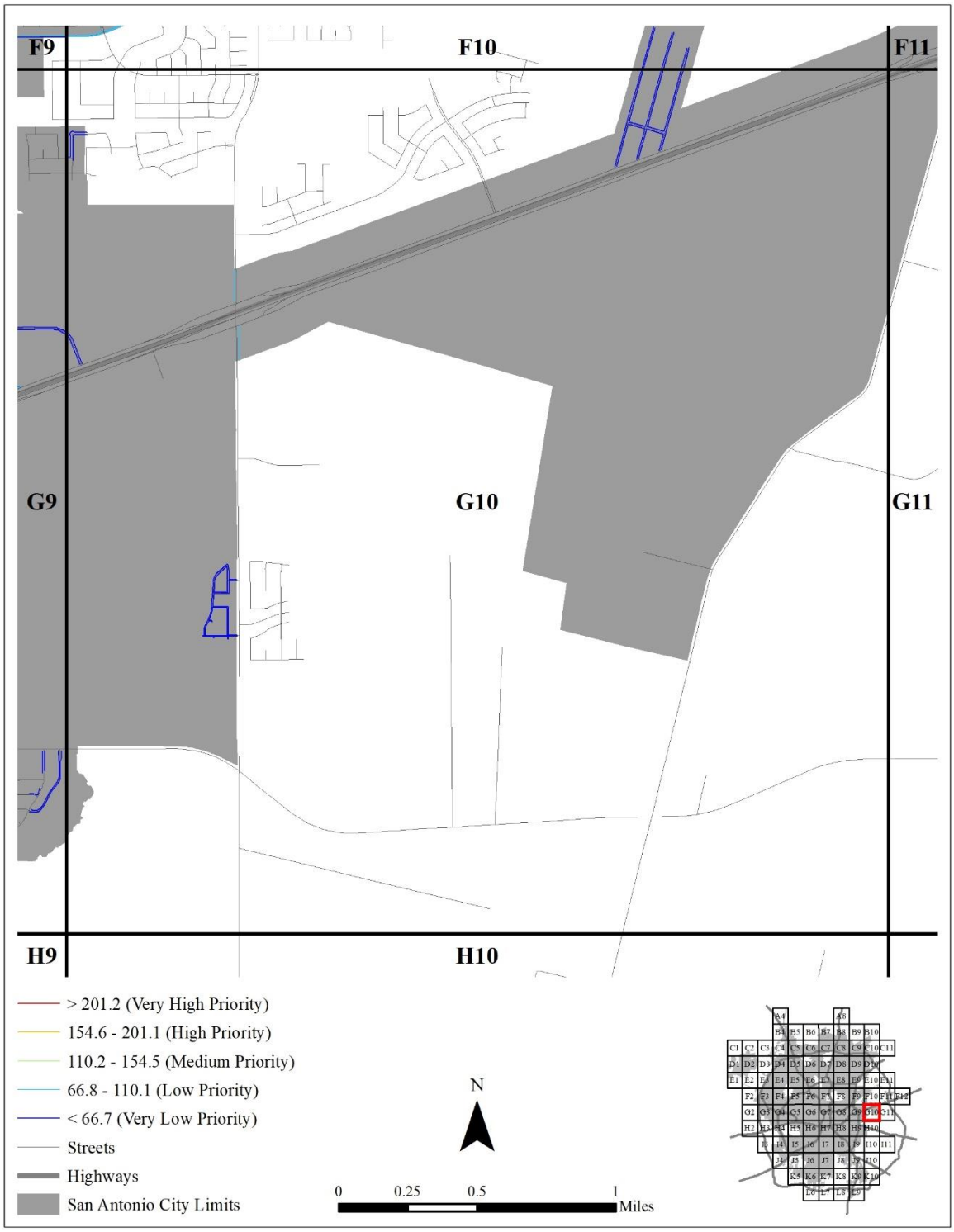

F4
F5
F6
G4
G5
G6
H4
H5
H6
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

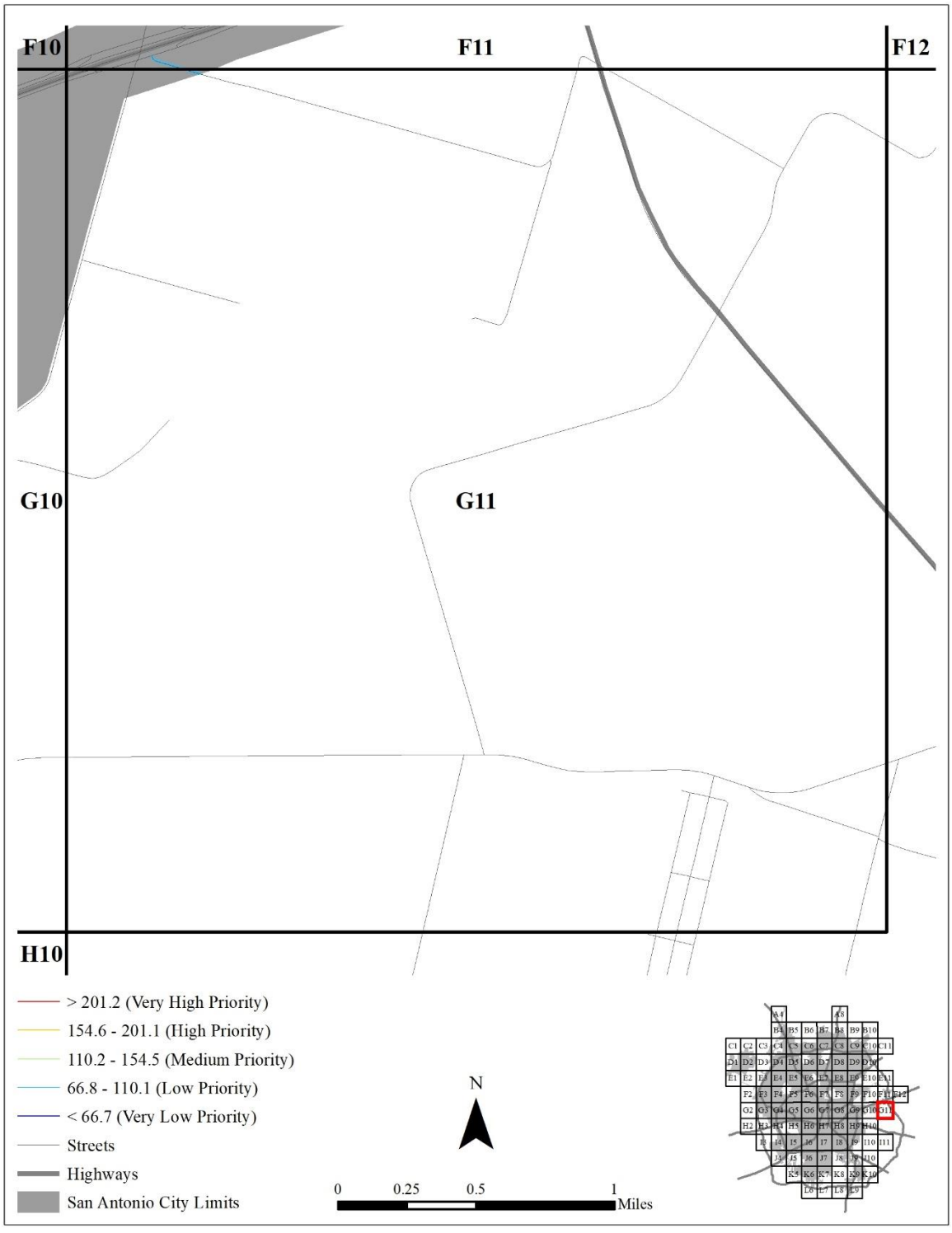

F5
F6
F7
G5
G6
G7
H5
H6
H7
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

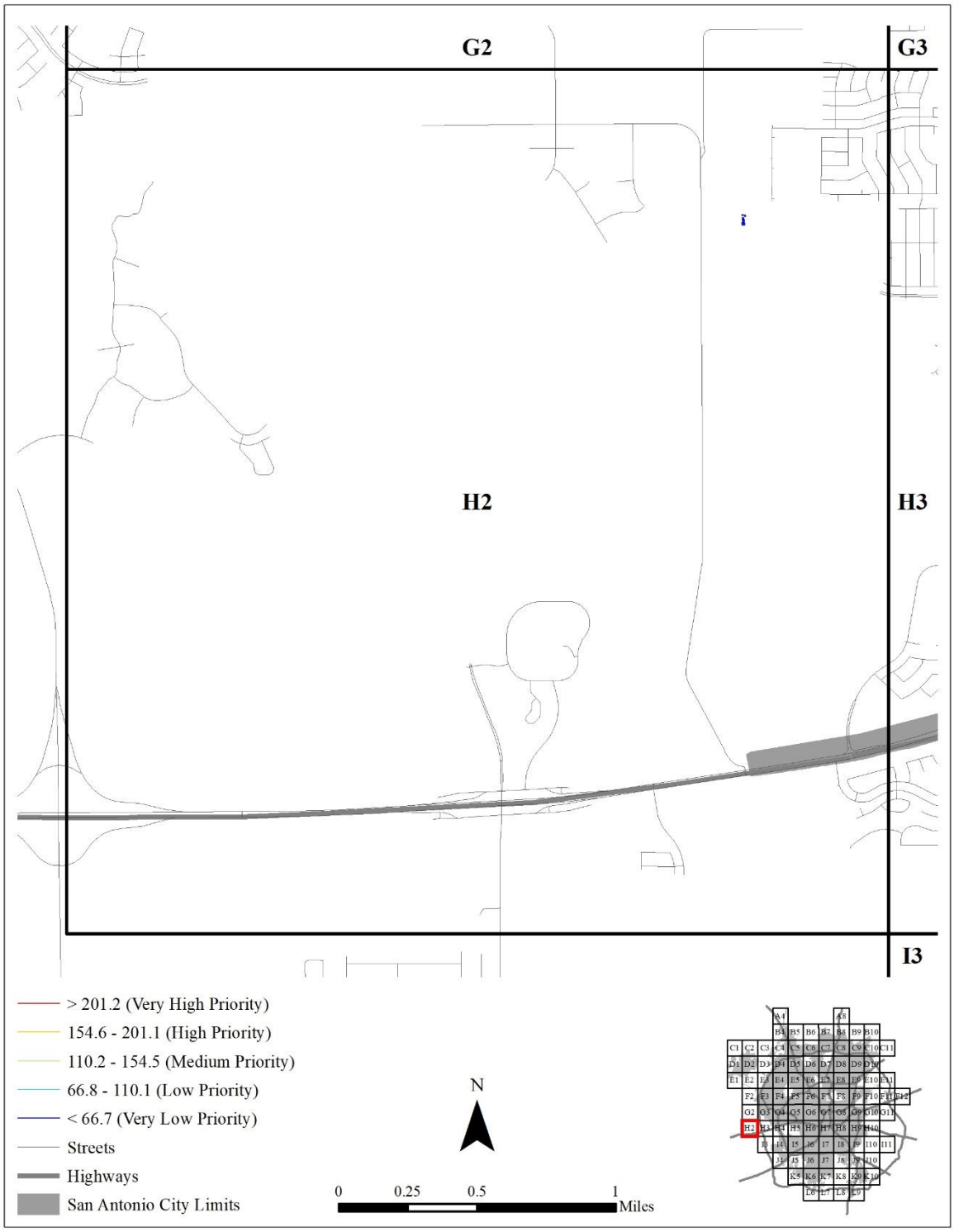

F6
F7
F8
G6
G7
G8
H6
H7
H8
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

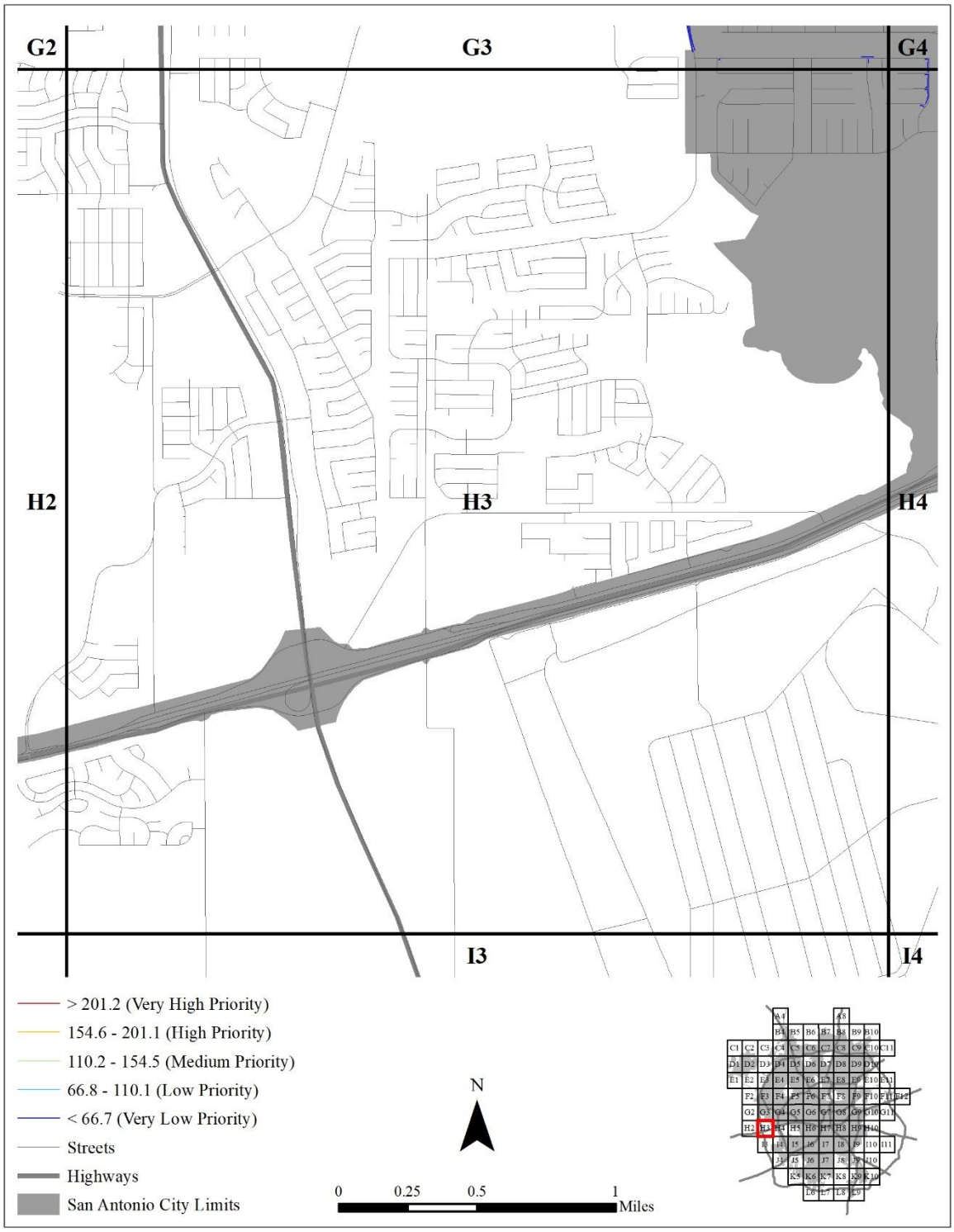

F7
F8
F9
G7
G8
G9
H7
H8
H9
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

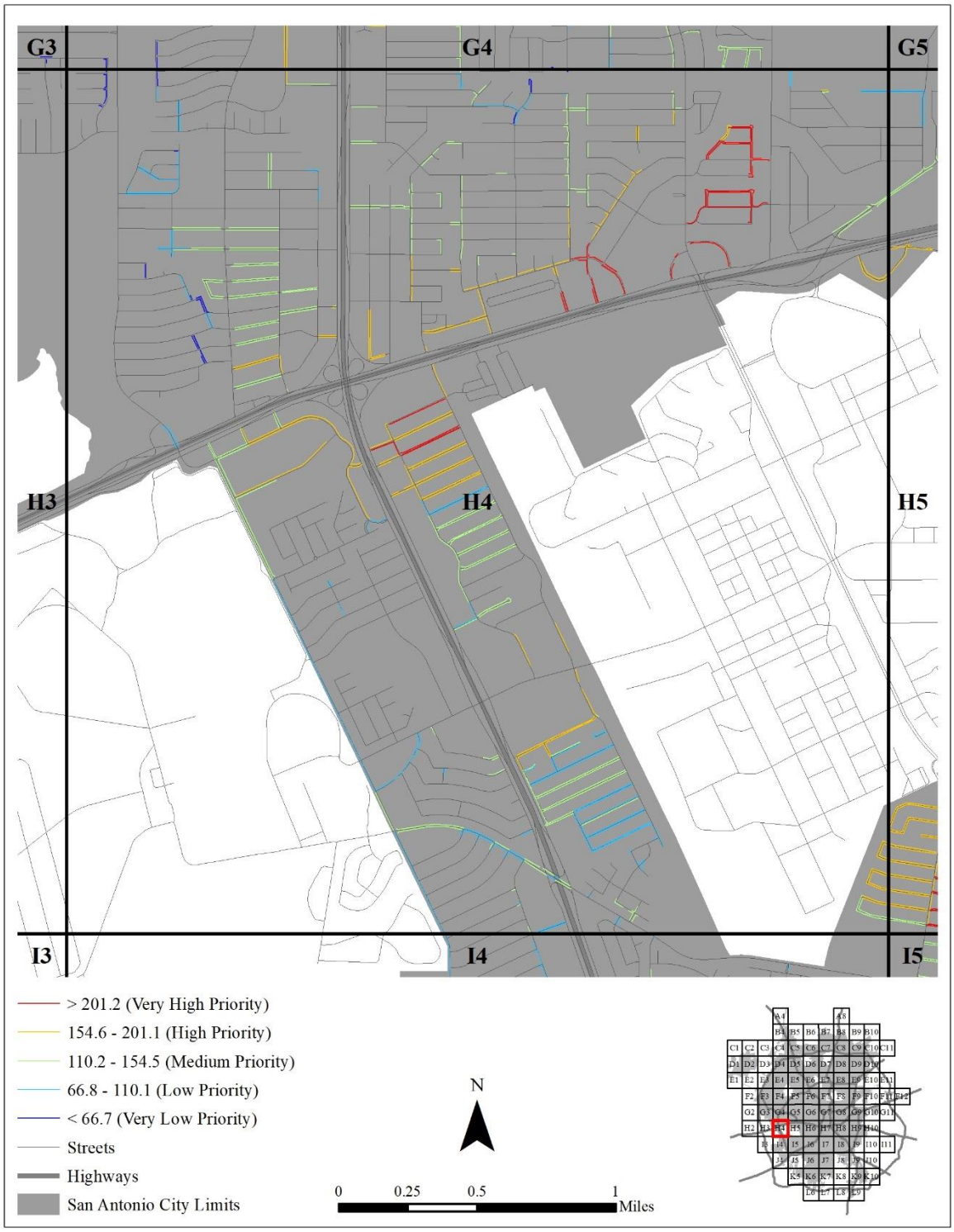

F8
F9
F10
G8
G9
G10
H8
H9
H10
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

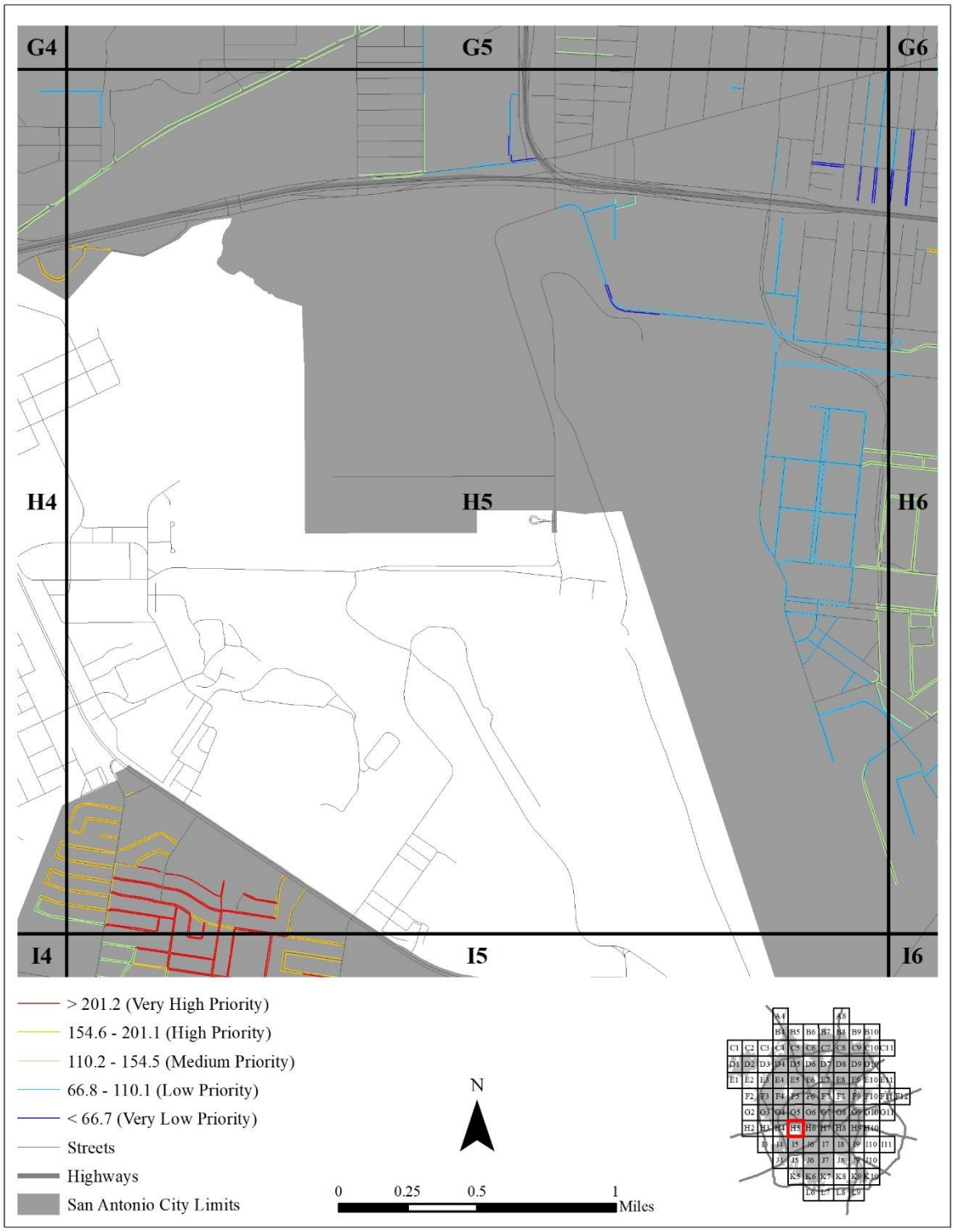

F9
F10
F11
G9
G10
G11
H9
H10
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

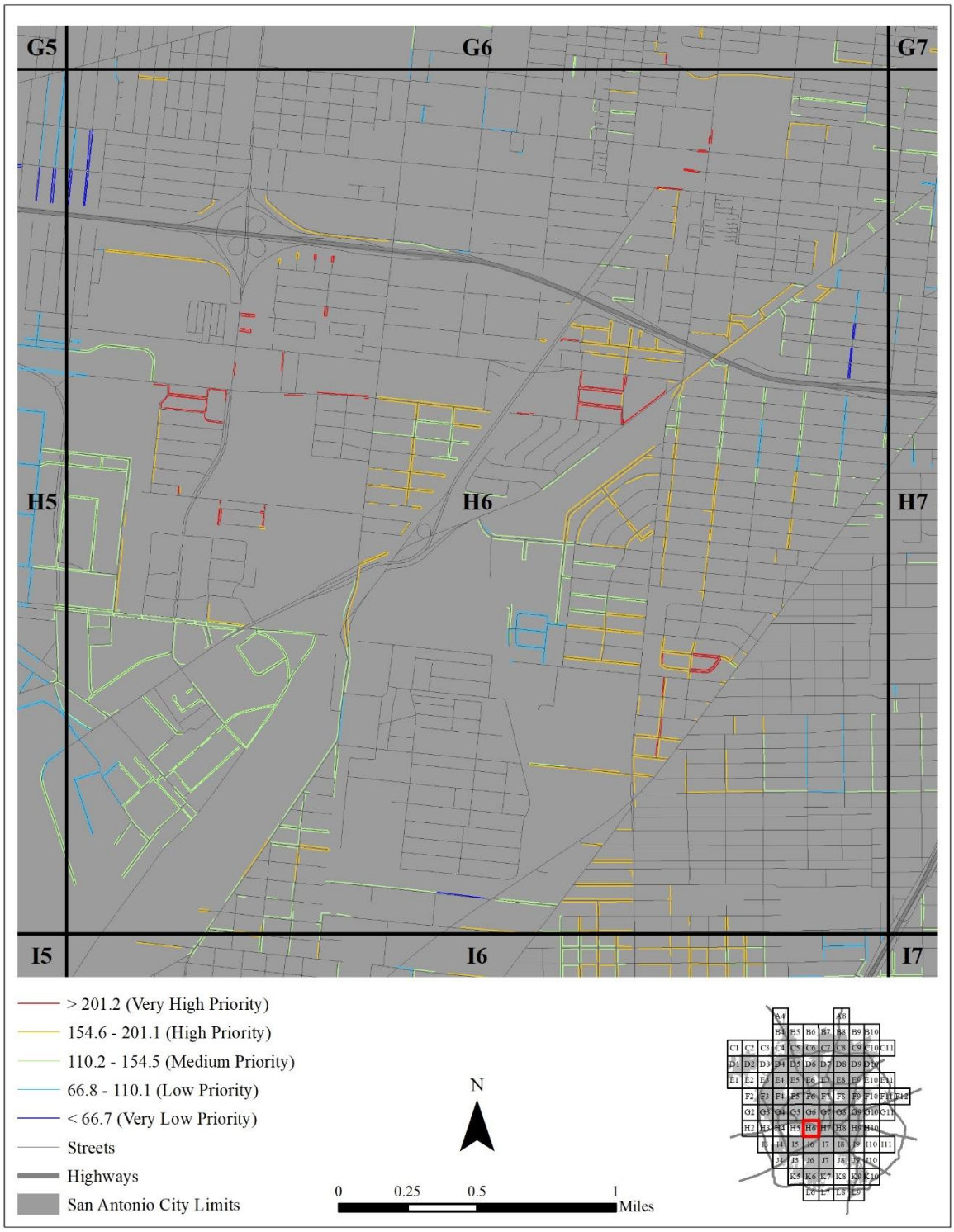

F10
F11
F12
G10
G11
H10
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

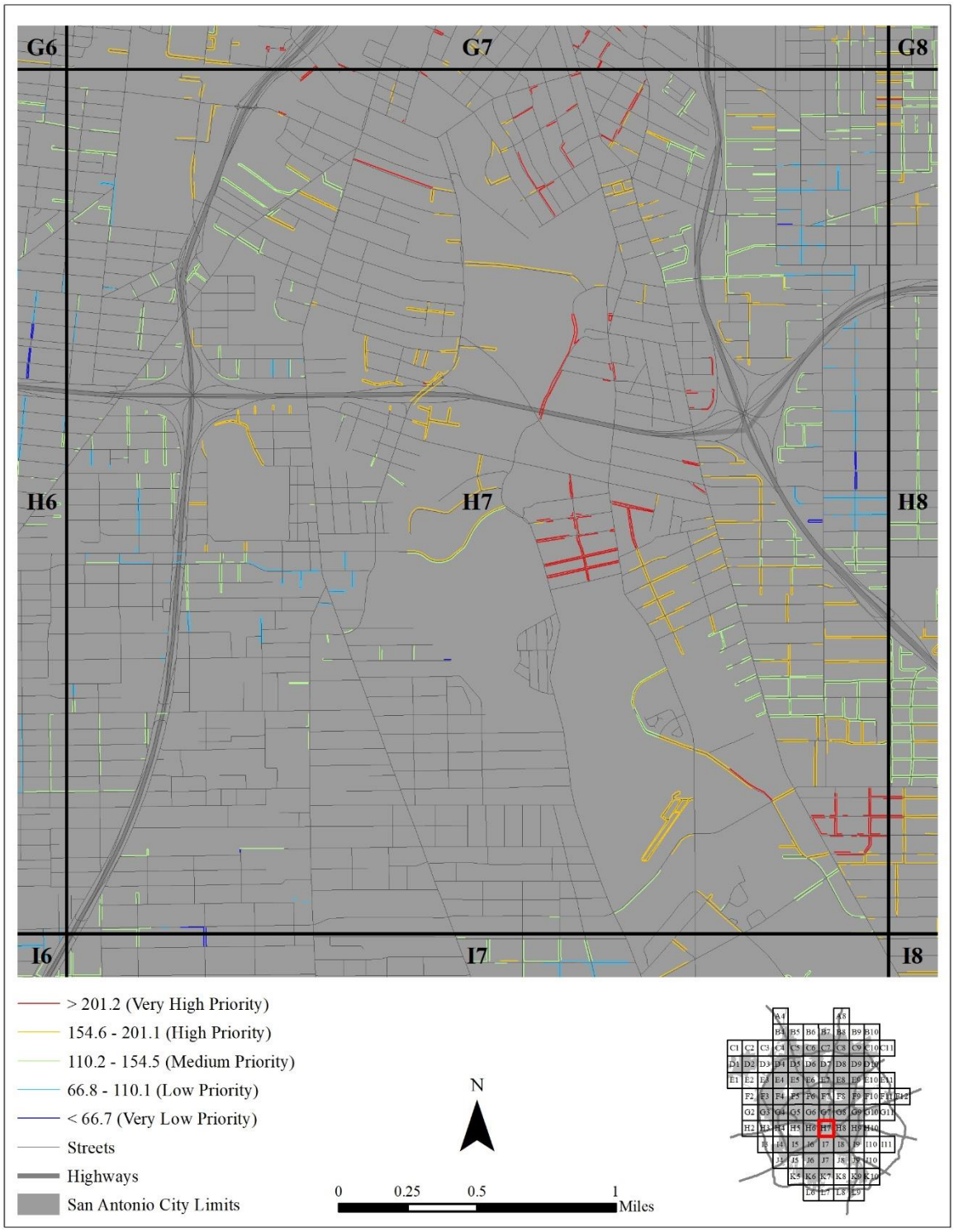

G2
G3
H2
H3
I3
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

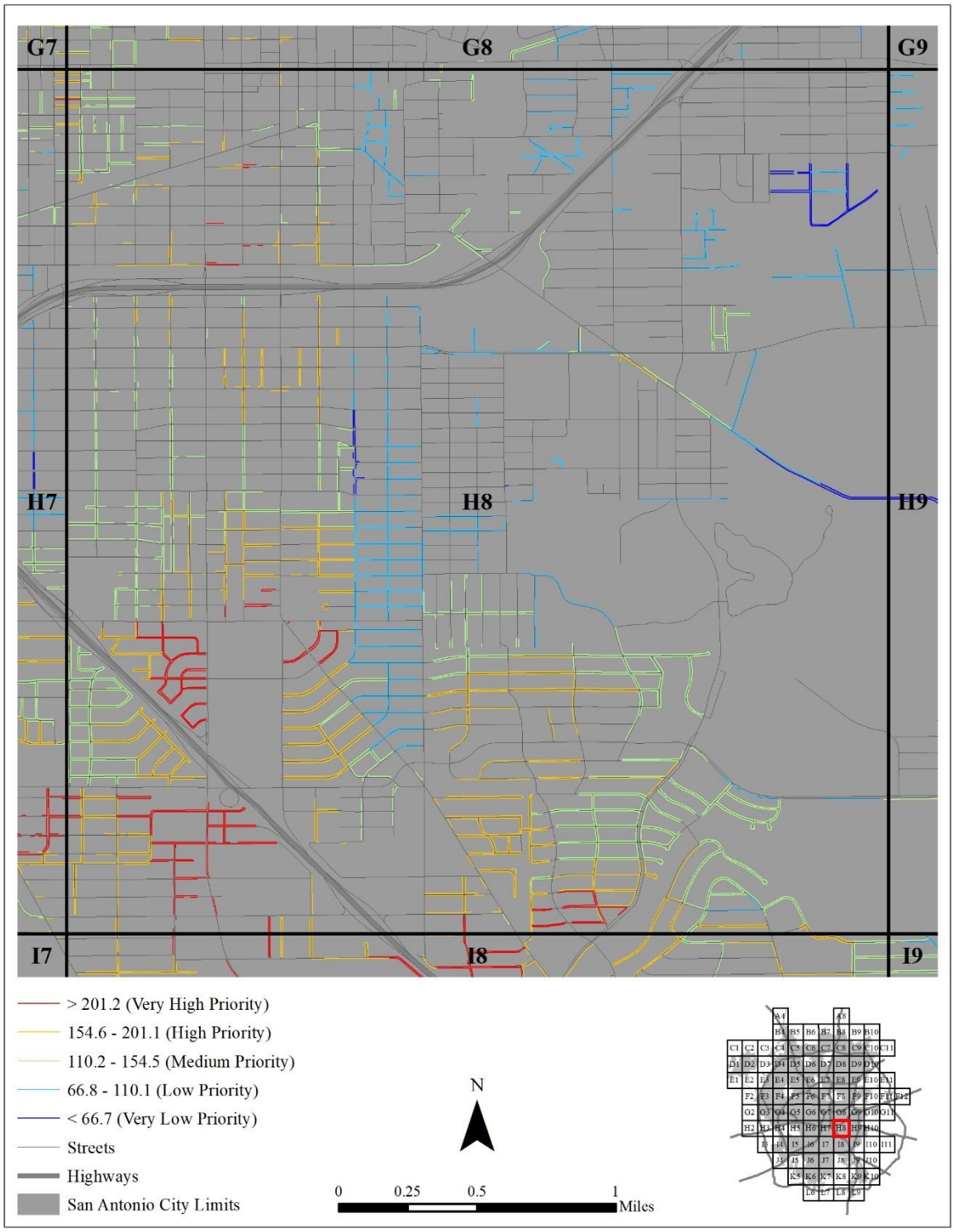

G2
G3
G4
H2
H3
H4
I3
I4
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

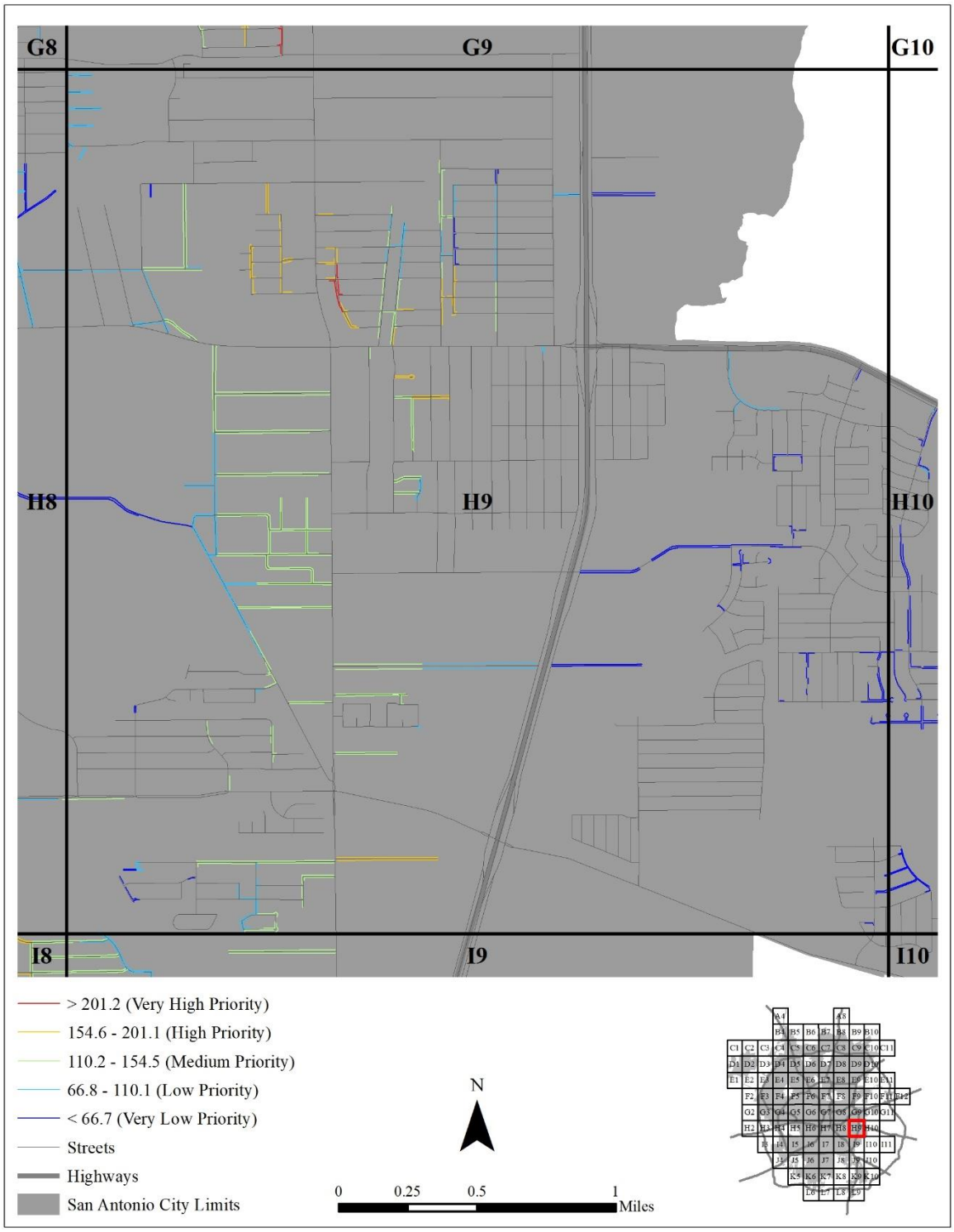

G3
G4
G5
H3
H4
H5
I3
I4
I5
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

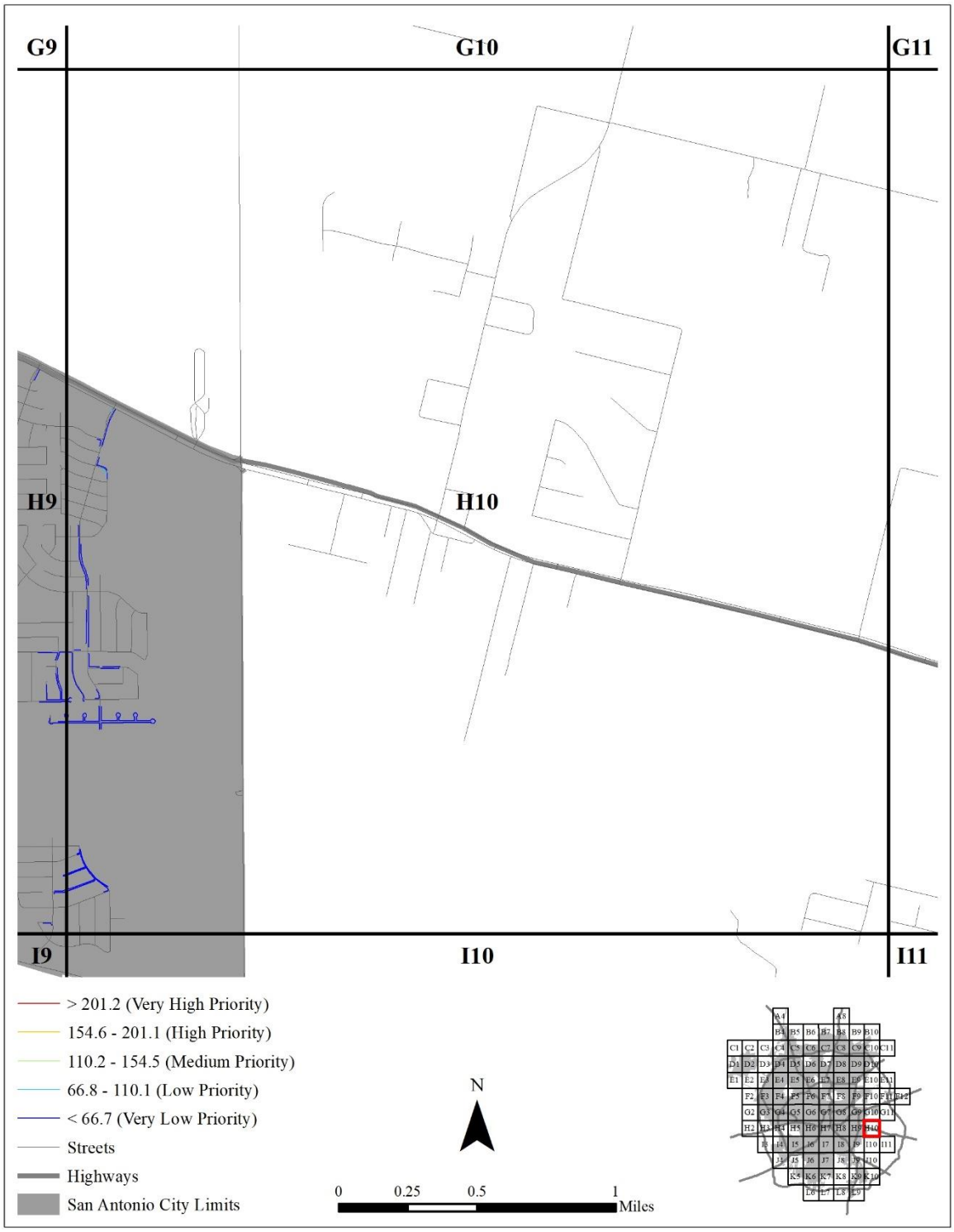

G4
G5
G6
H4
H5
H6
I4
I5
I6
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

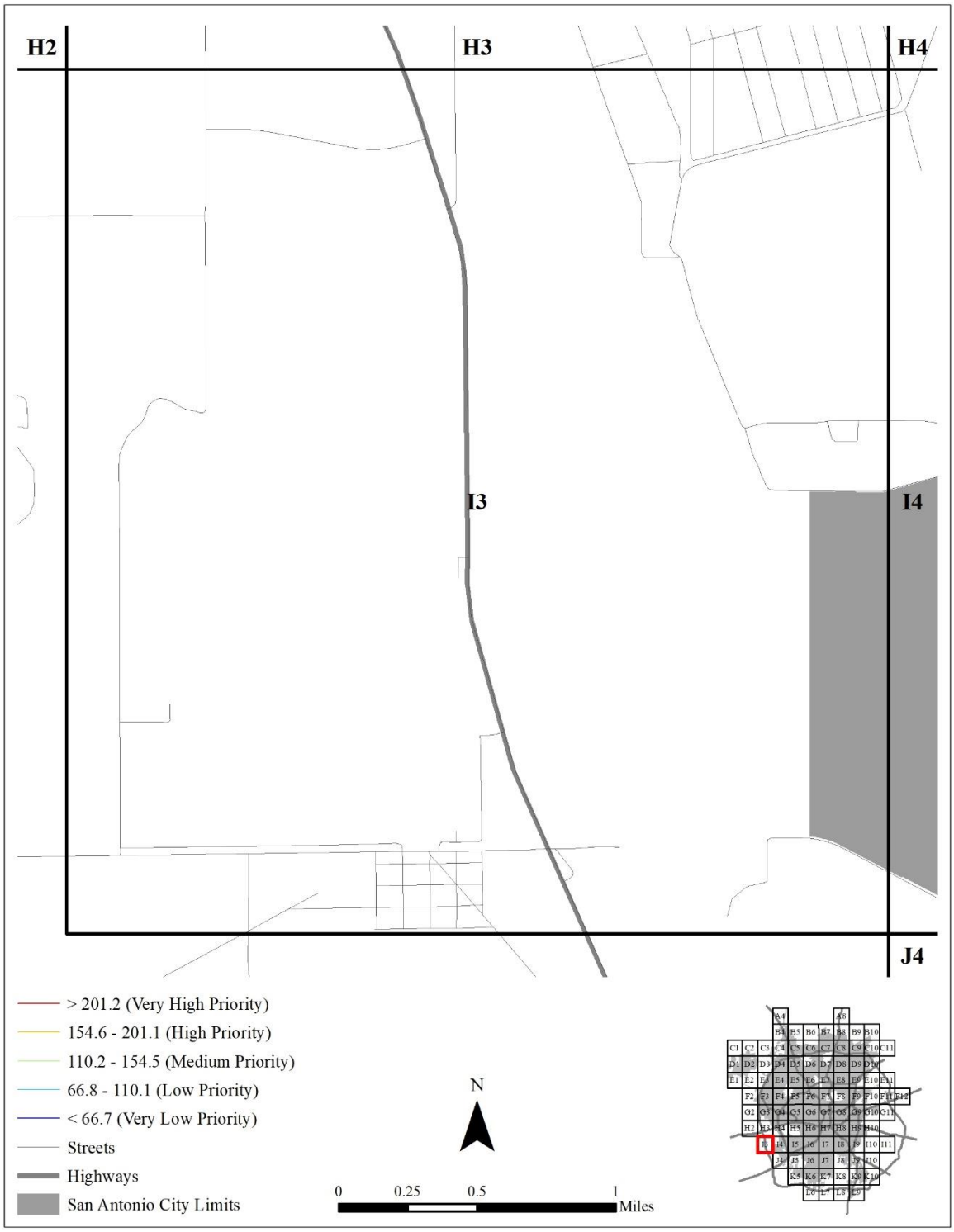

G5
G6
G7
H5
H6
H7
I5
I6
I7
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

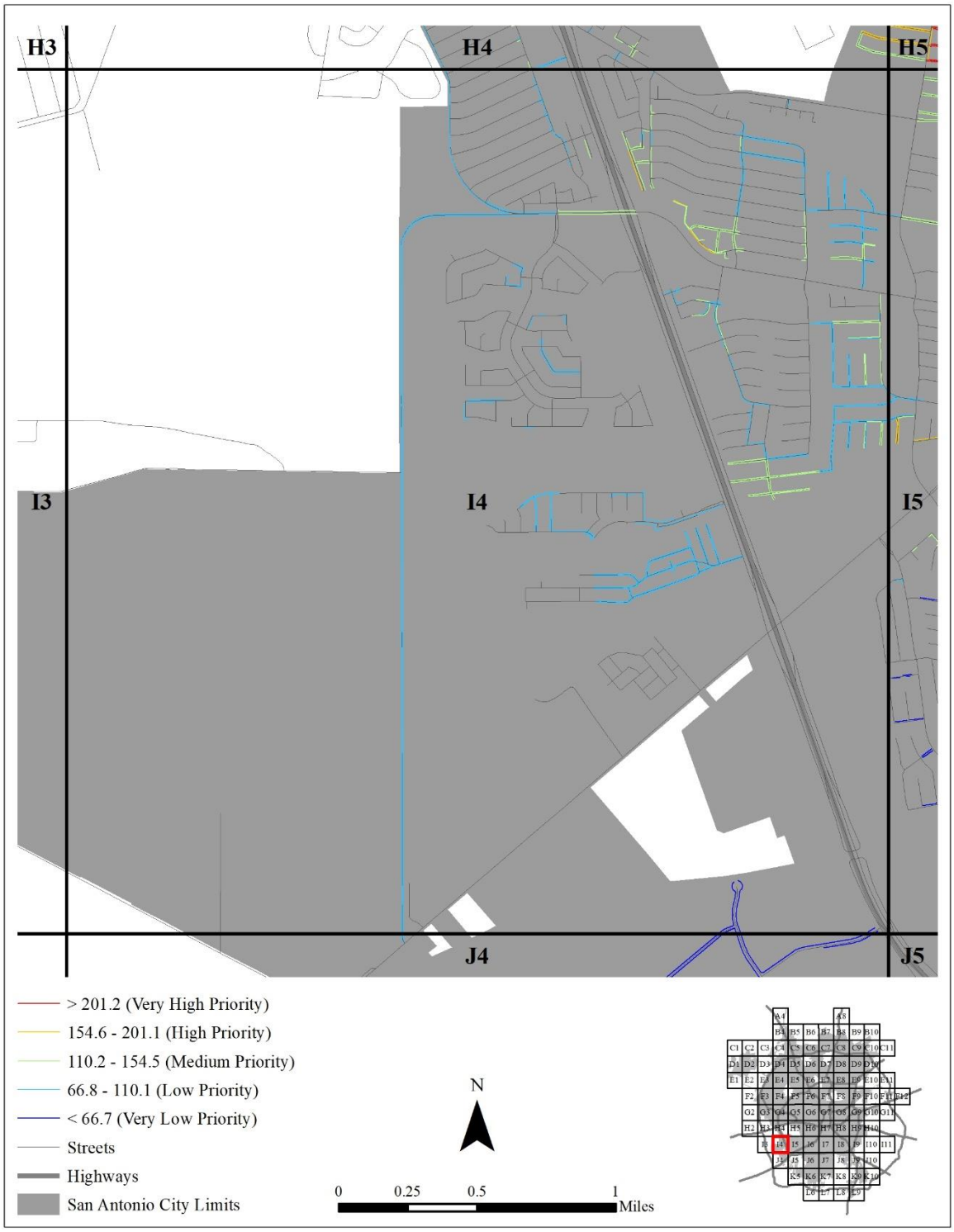

G6
G7
G8
H6
H7
H8
I6
I7
I8
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

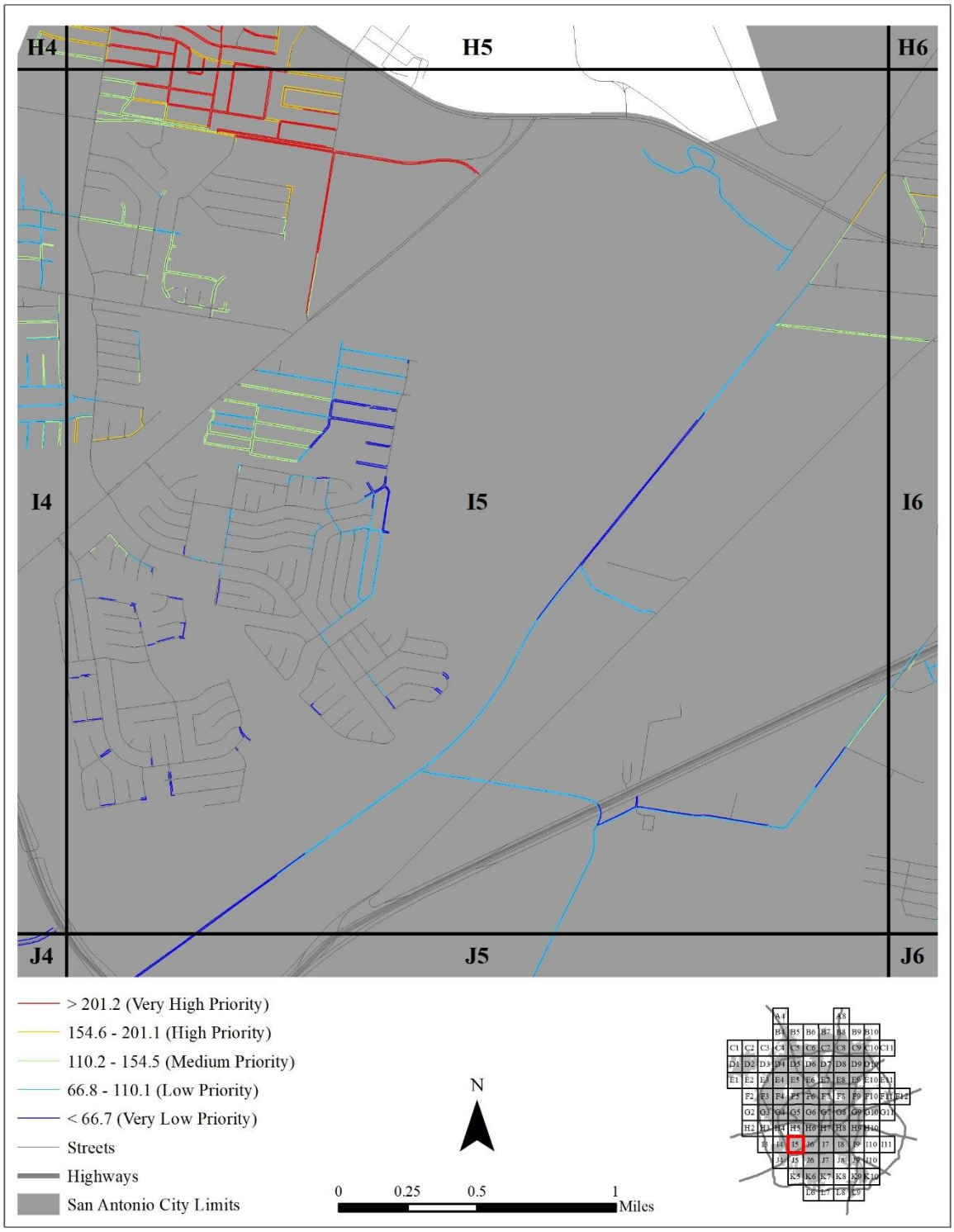

G7
G8
G9
H7
H8
H9
I7
I8
I9
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

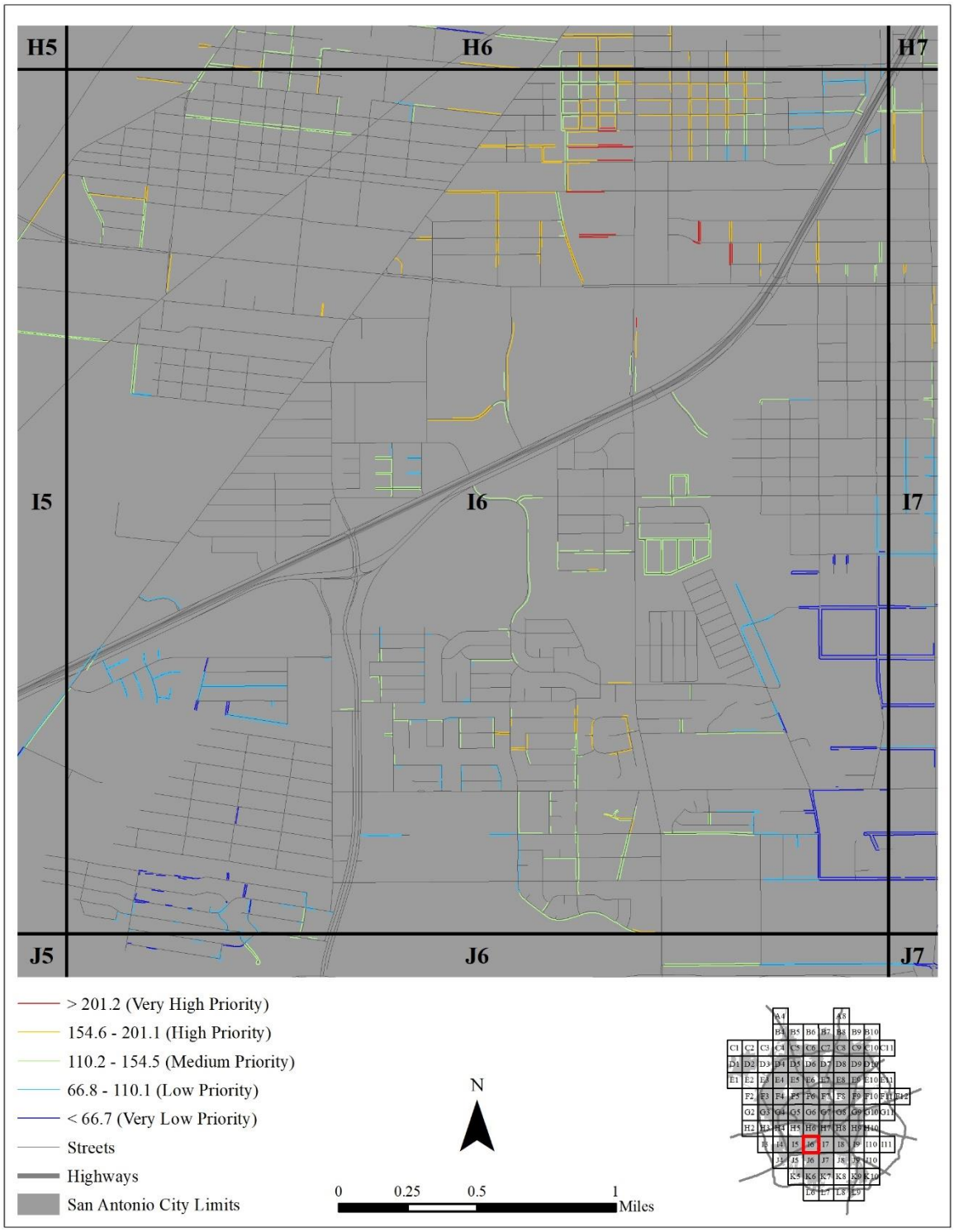

G8
G9
G10
H8
H9
H10
I8
I9
I10
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

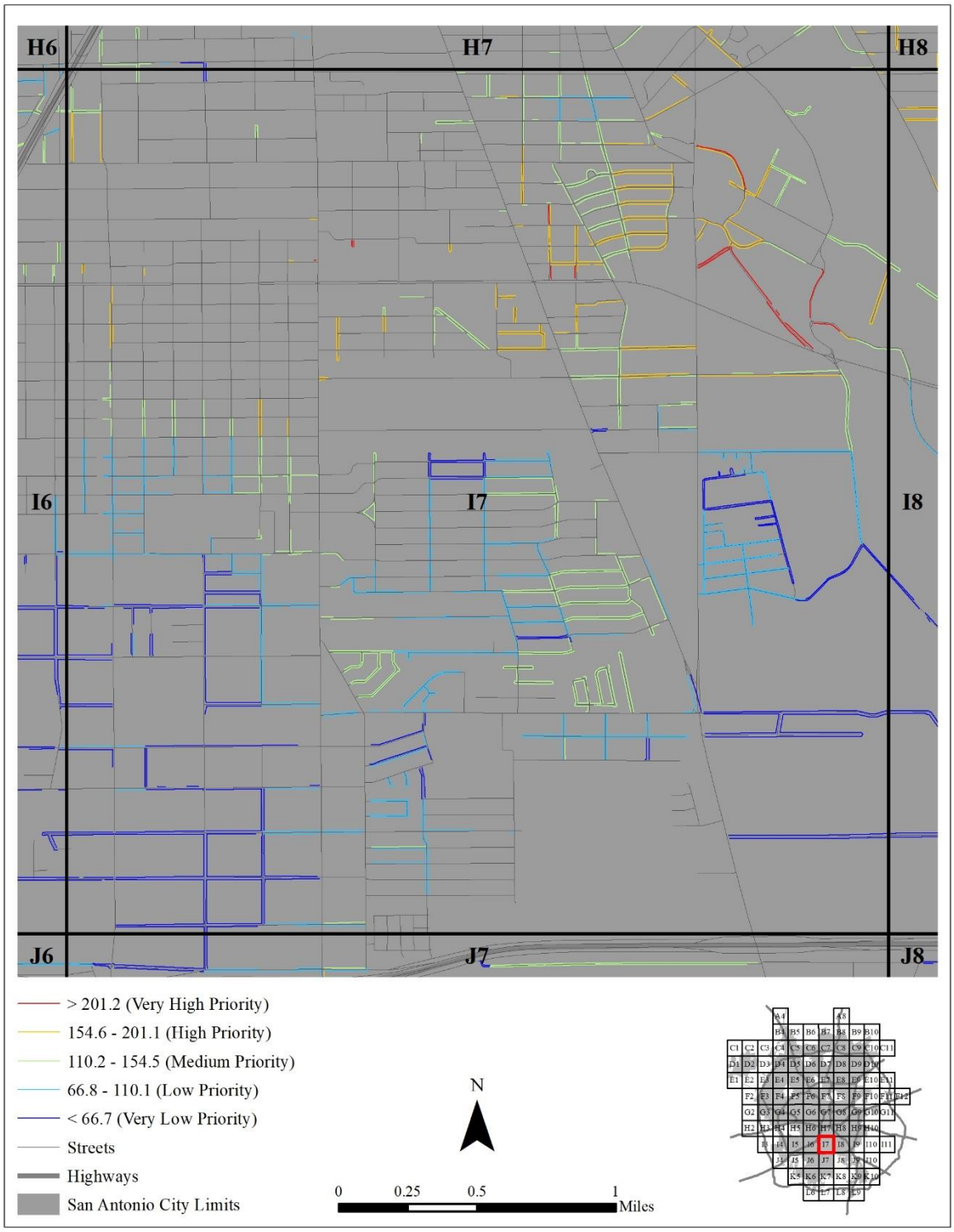

G9
G10
G11
H9
H10
I9
I10
I11
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

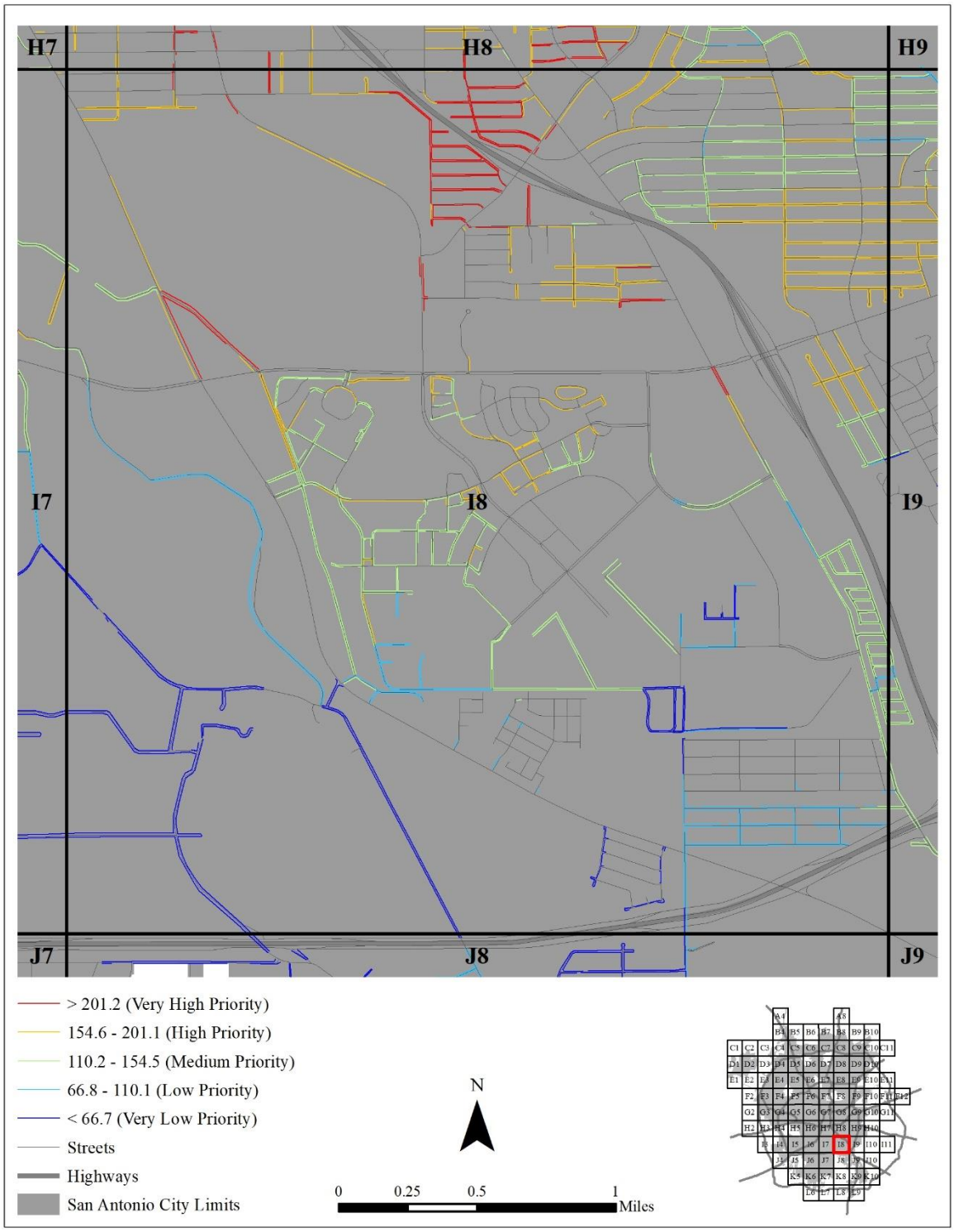

H2
H3
H4
I3
I4
J4
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

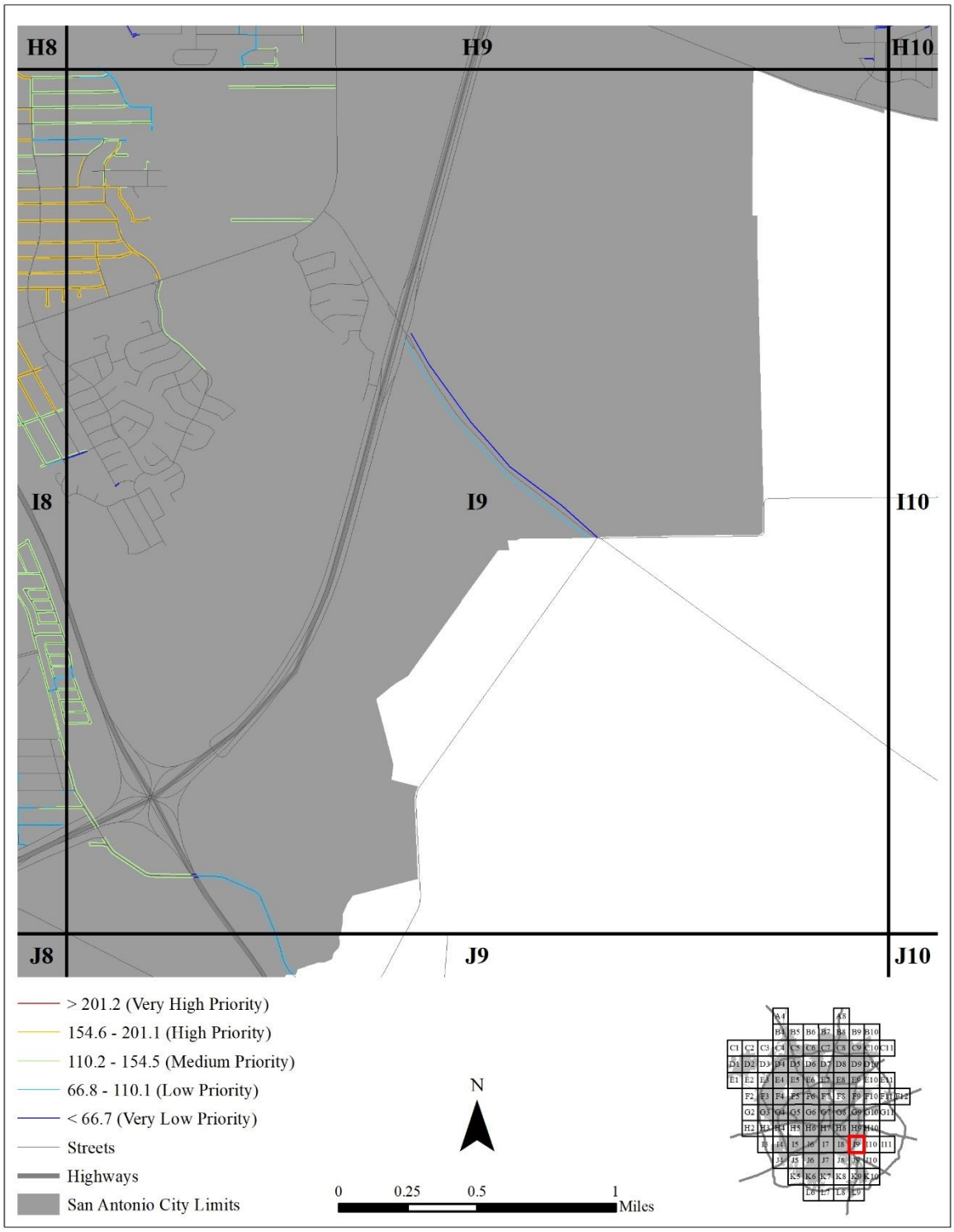

H3
H4
H5
I3
I4
I5
J4
J5
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

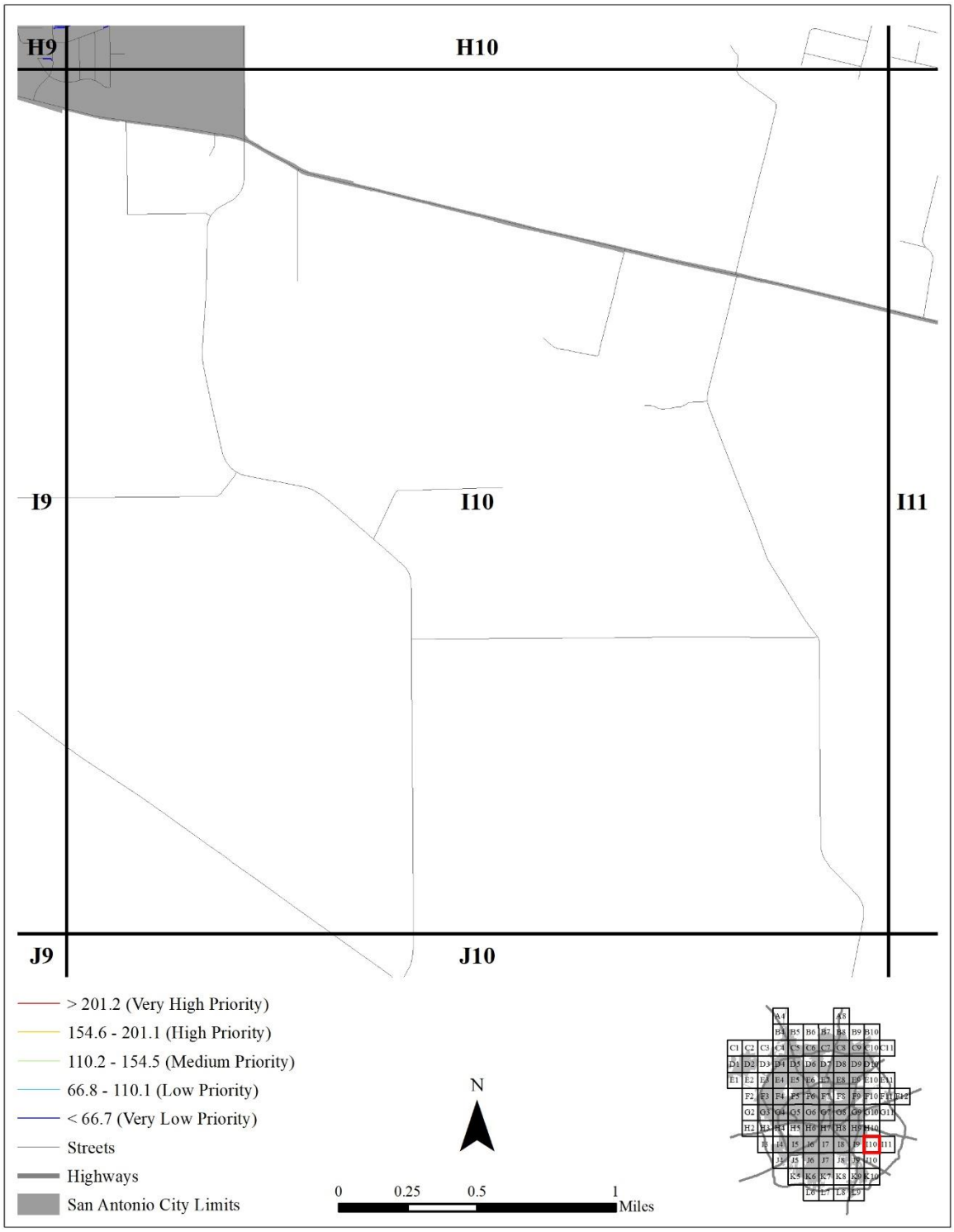

H4
H5
H6
I4
I5
I6
J4
J5
J6
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

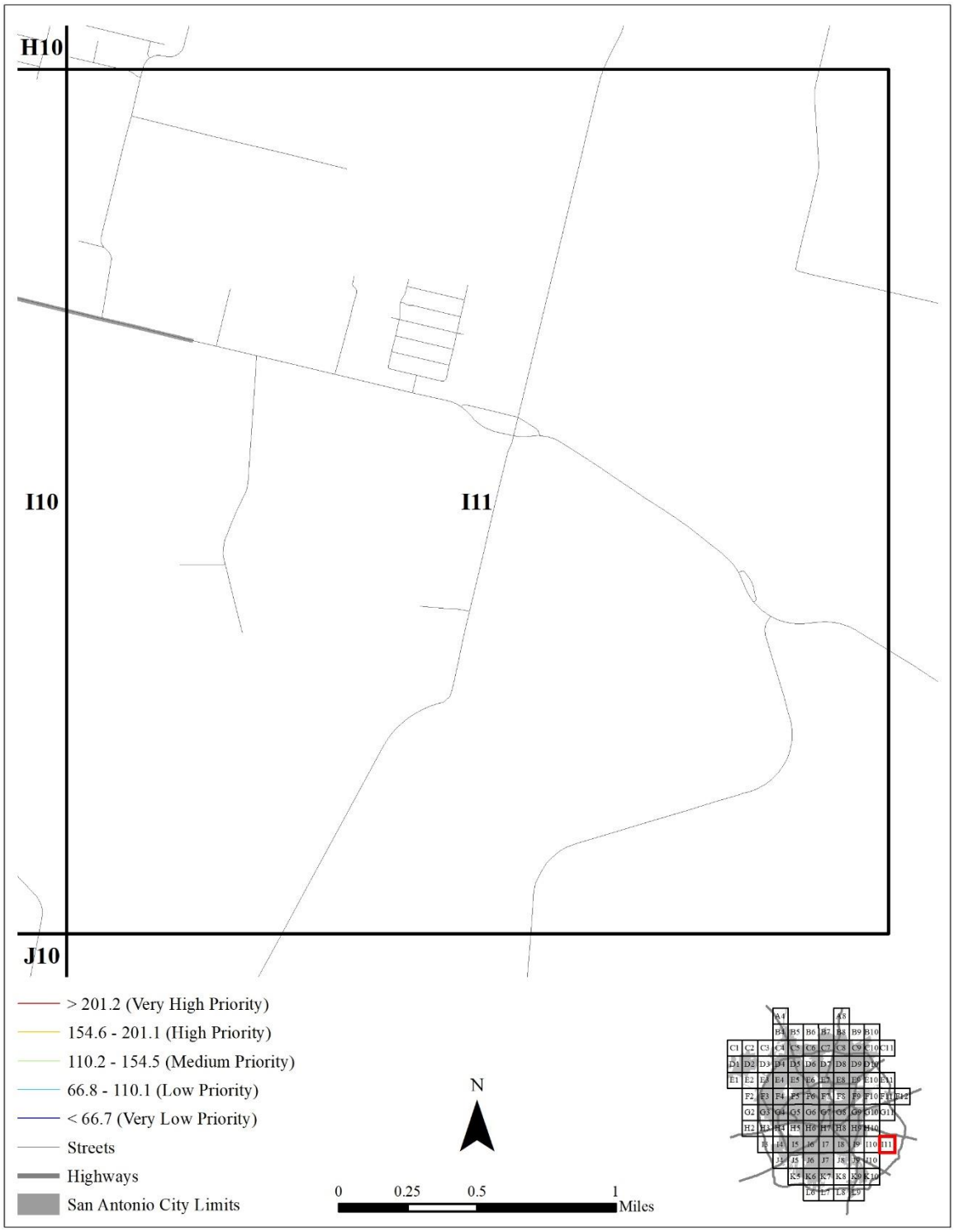

H5
H6
H7
I5
I6
I7
J5
J6
J7
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles


H6
H7
H8
I6
I7
I8
J6
J7
J8
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

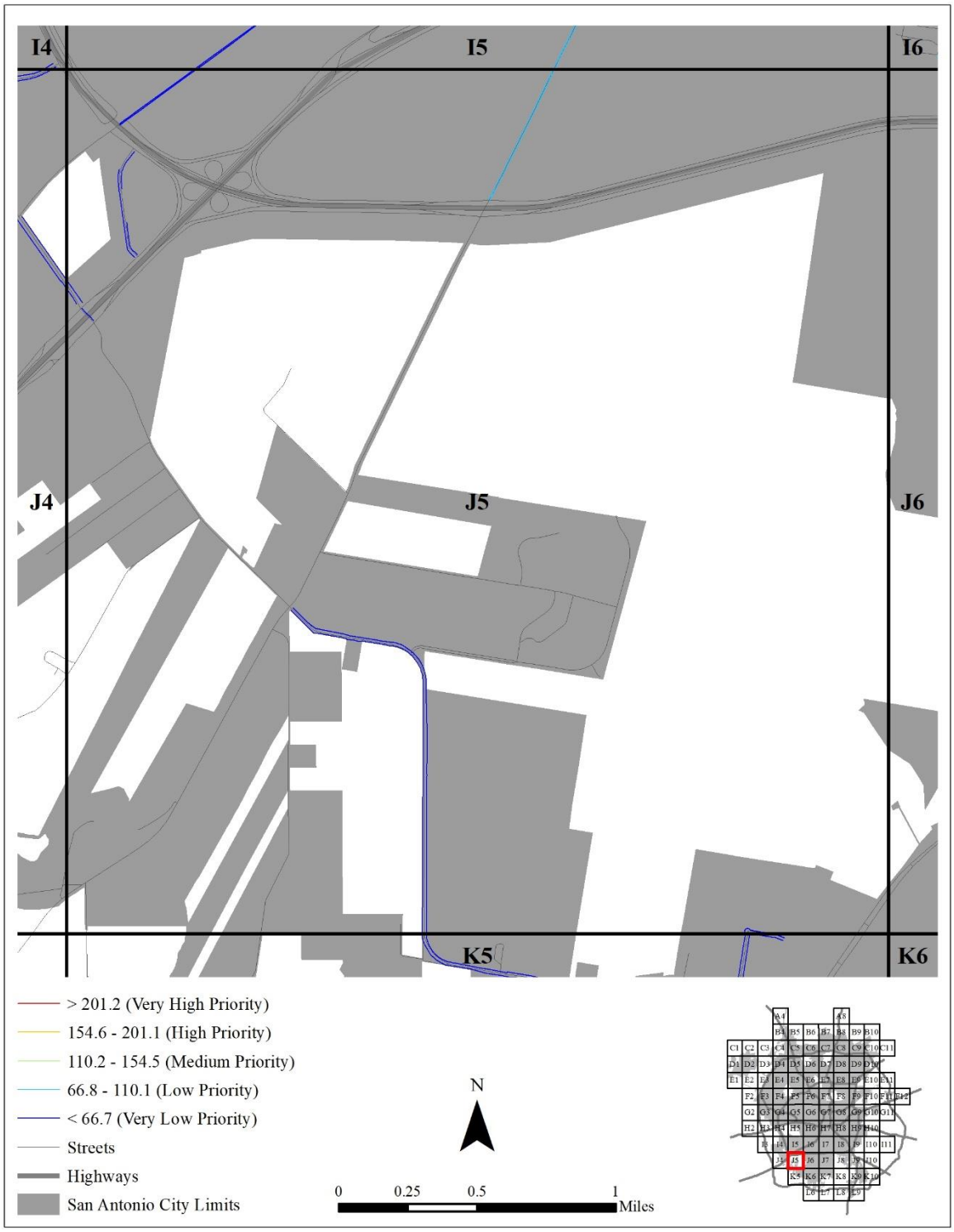

H7
H8
H9
I7
I8
I9
J7
J8
J9
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

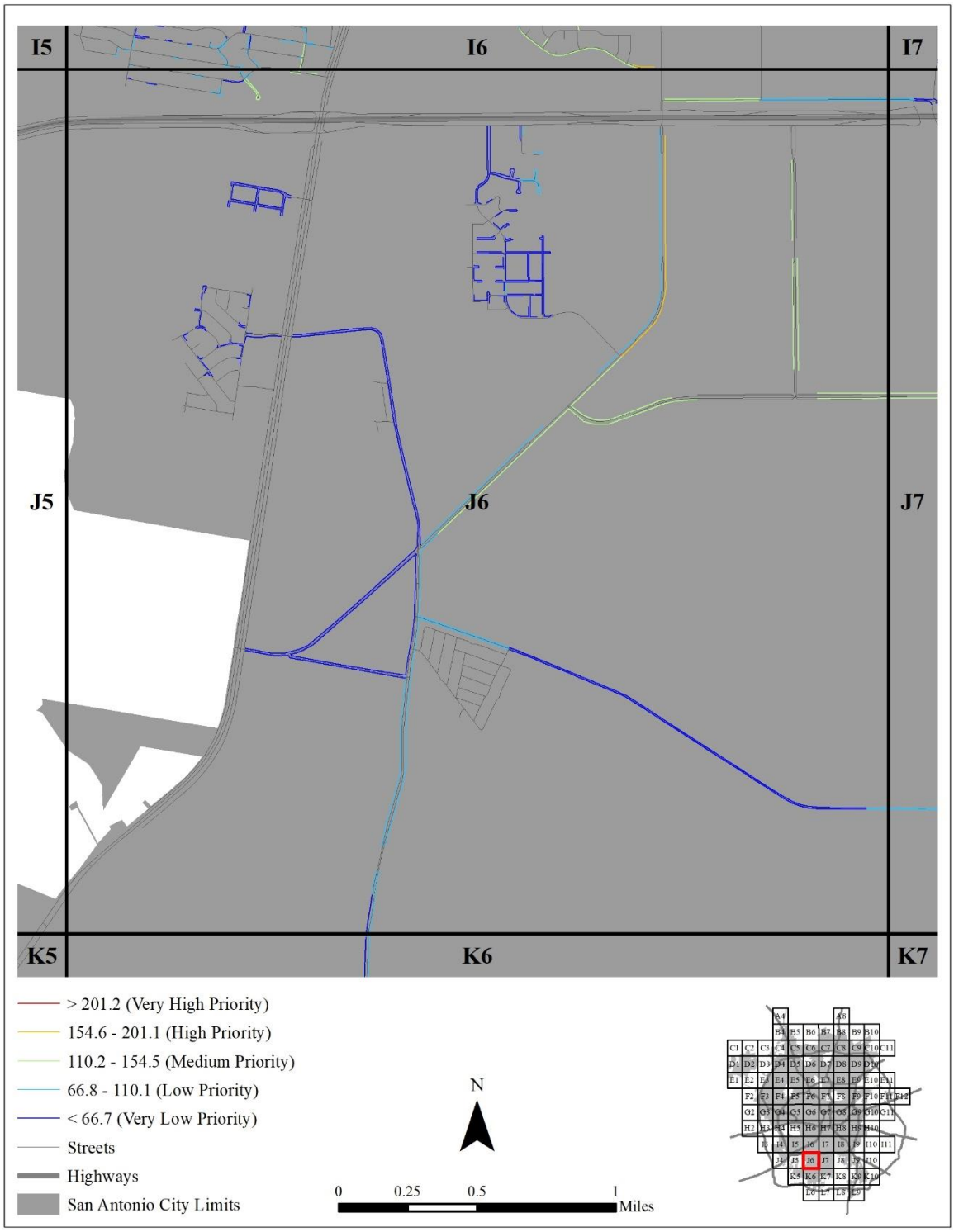

H8
H9
H10
I8
I9
I10
J8
J9
J10
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

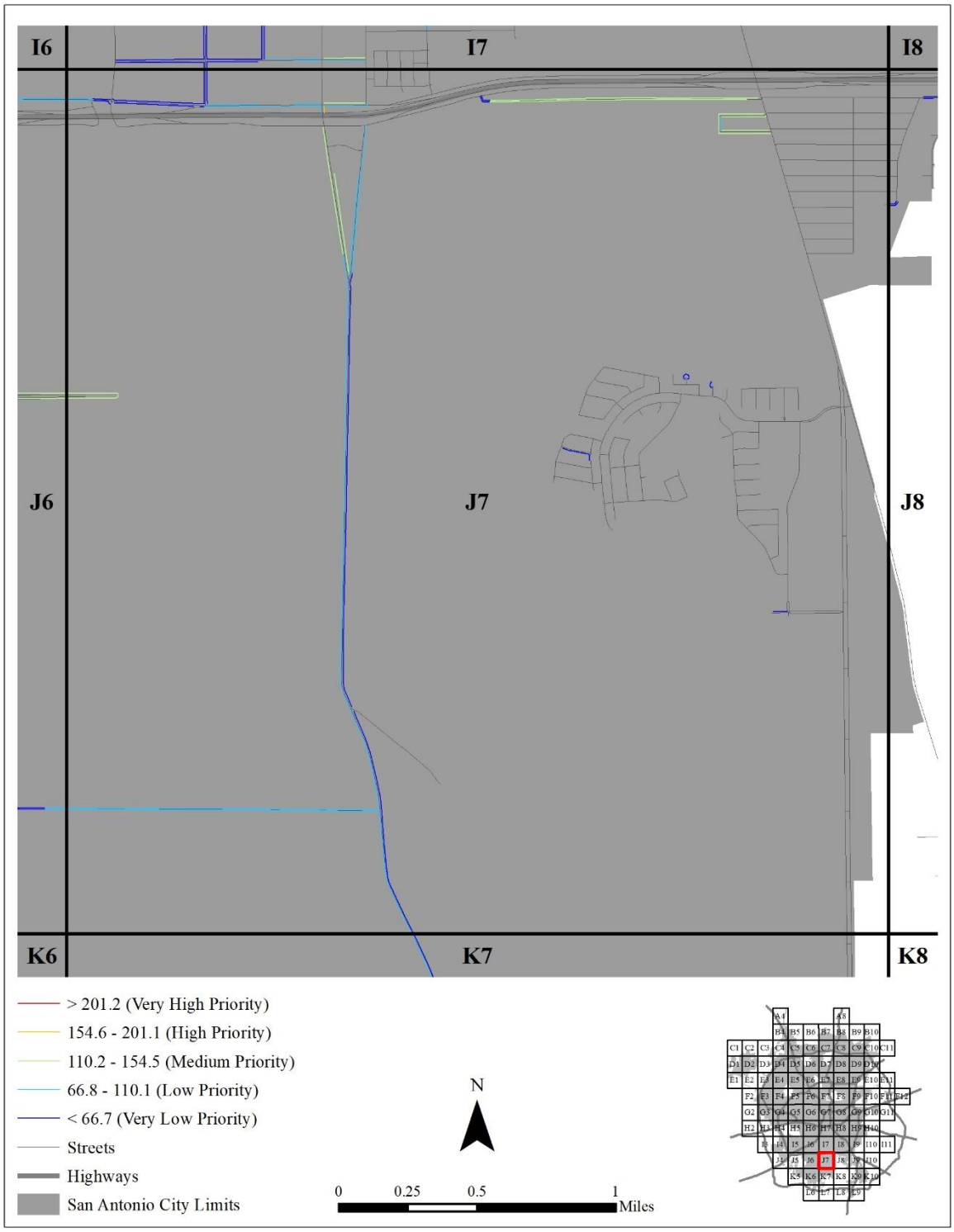

H9
H10
I9
I10
I11
J9
J10
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles


H10
I10
I11
J10
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

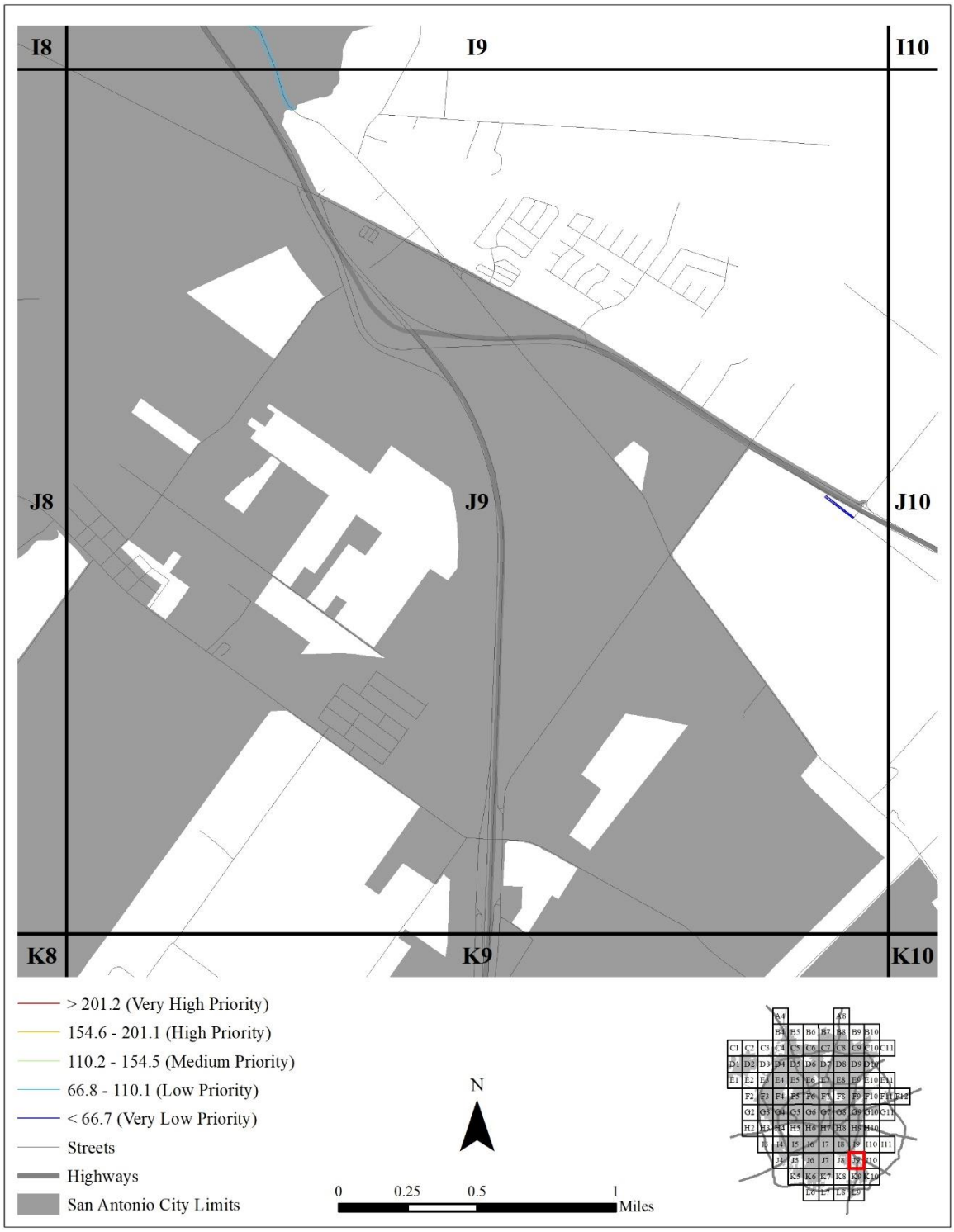

I3
I4
I5
J4
J5
K5
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

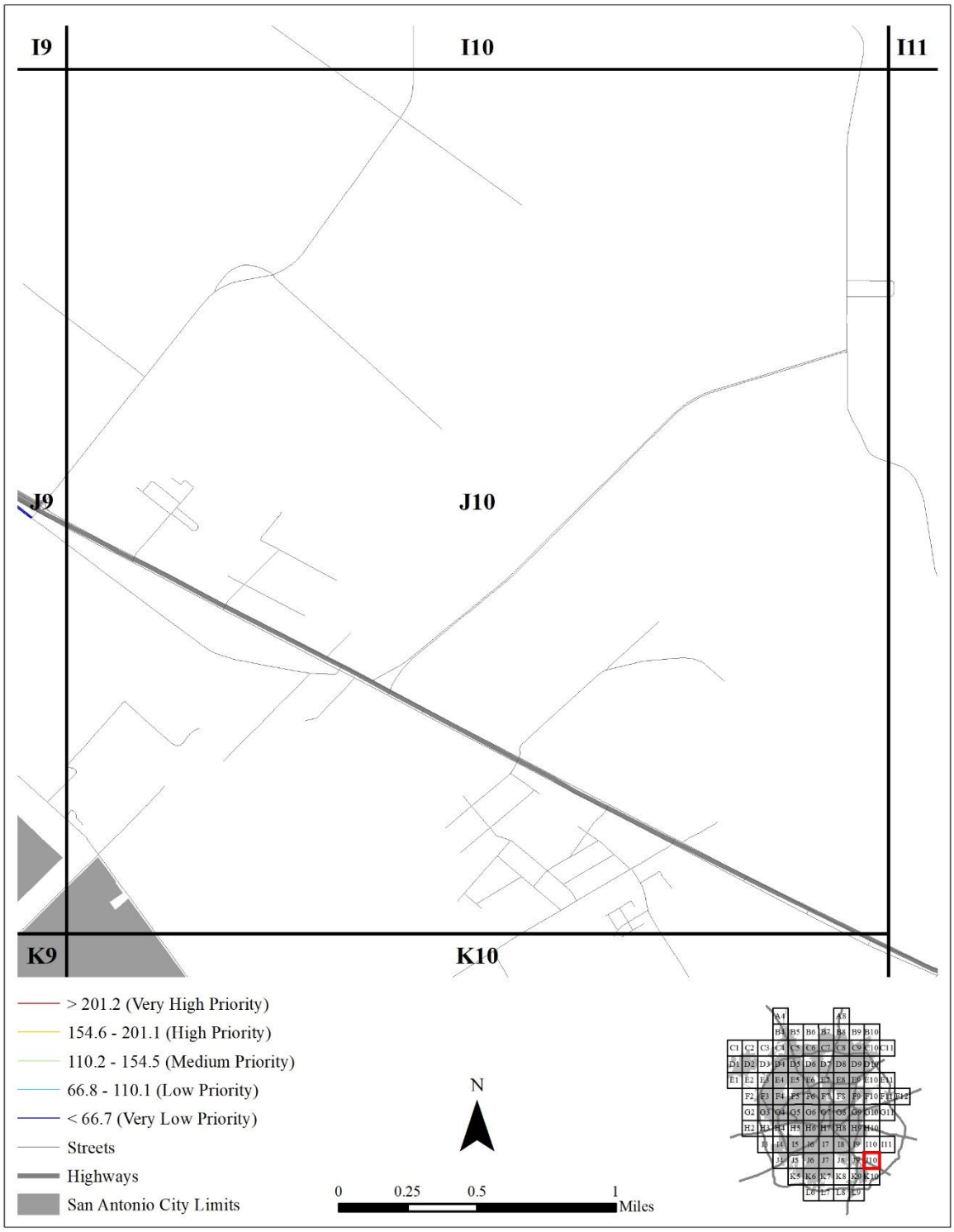

I4
I5
I6
J4
J5
J6
K5
K6
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

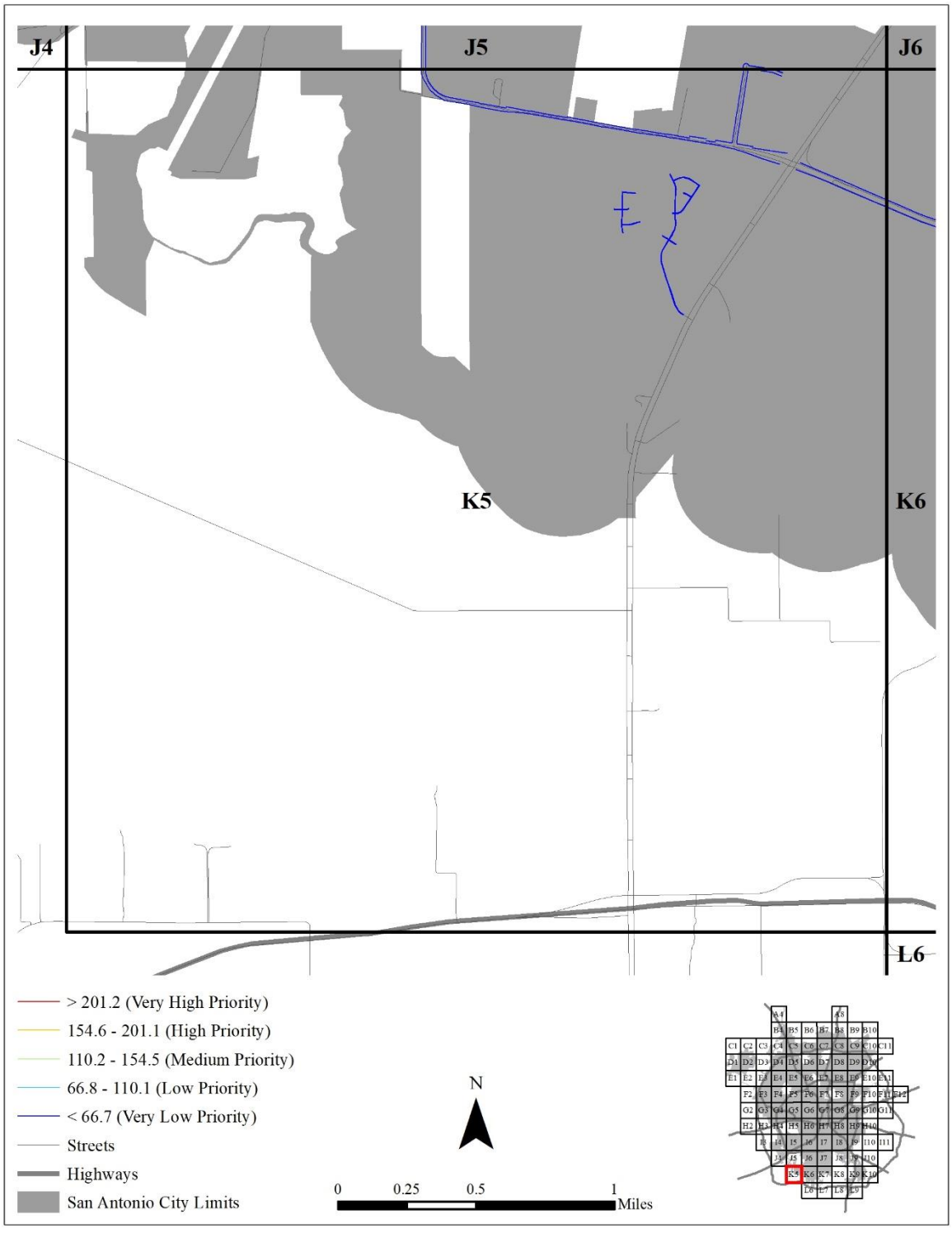

I5
I6
I7
J5
J6
J7
K5
K6
K7
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

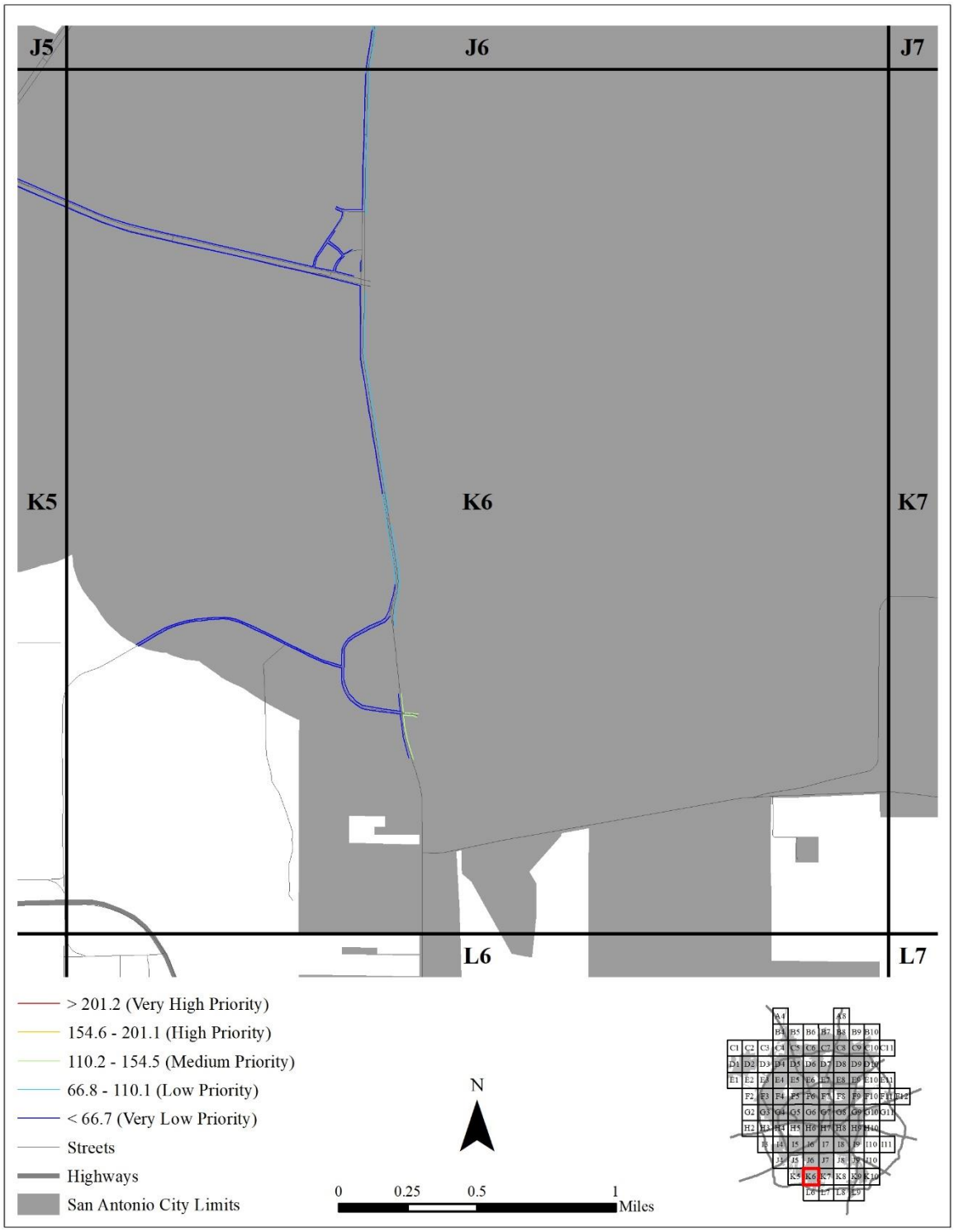

I6
I7
I8
J6
J7
J8
K6
K7
K8
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

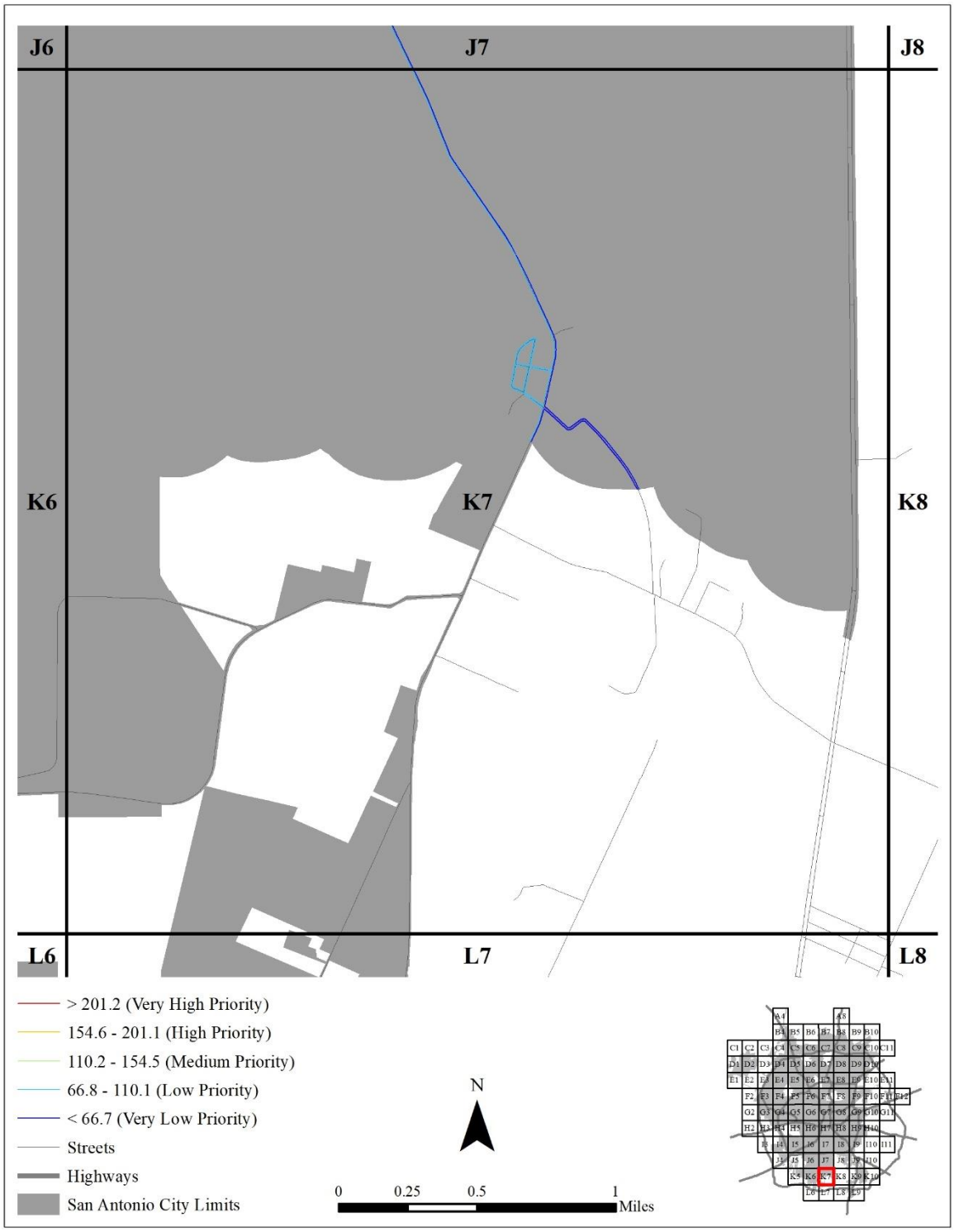

I7
I8
I9
J7
J8
J9
K7
K8
K9
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

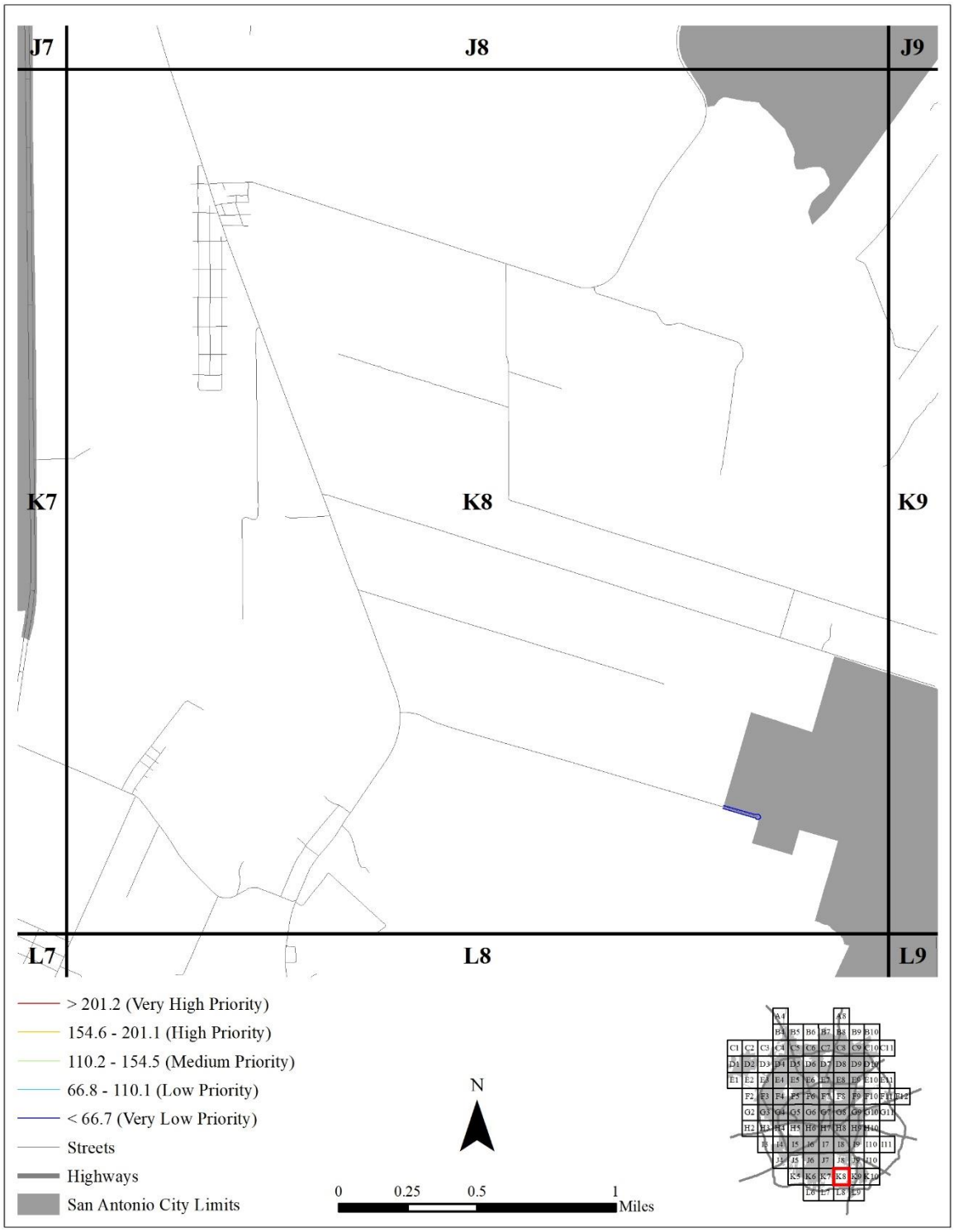

I8
I9
I10
J8
J9
J10
K8
K9
K10
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

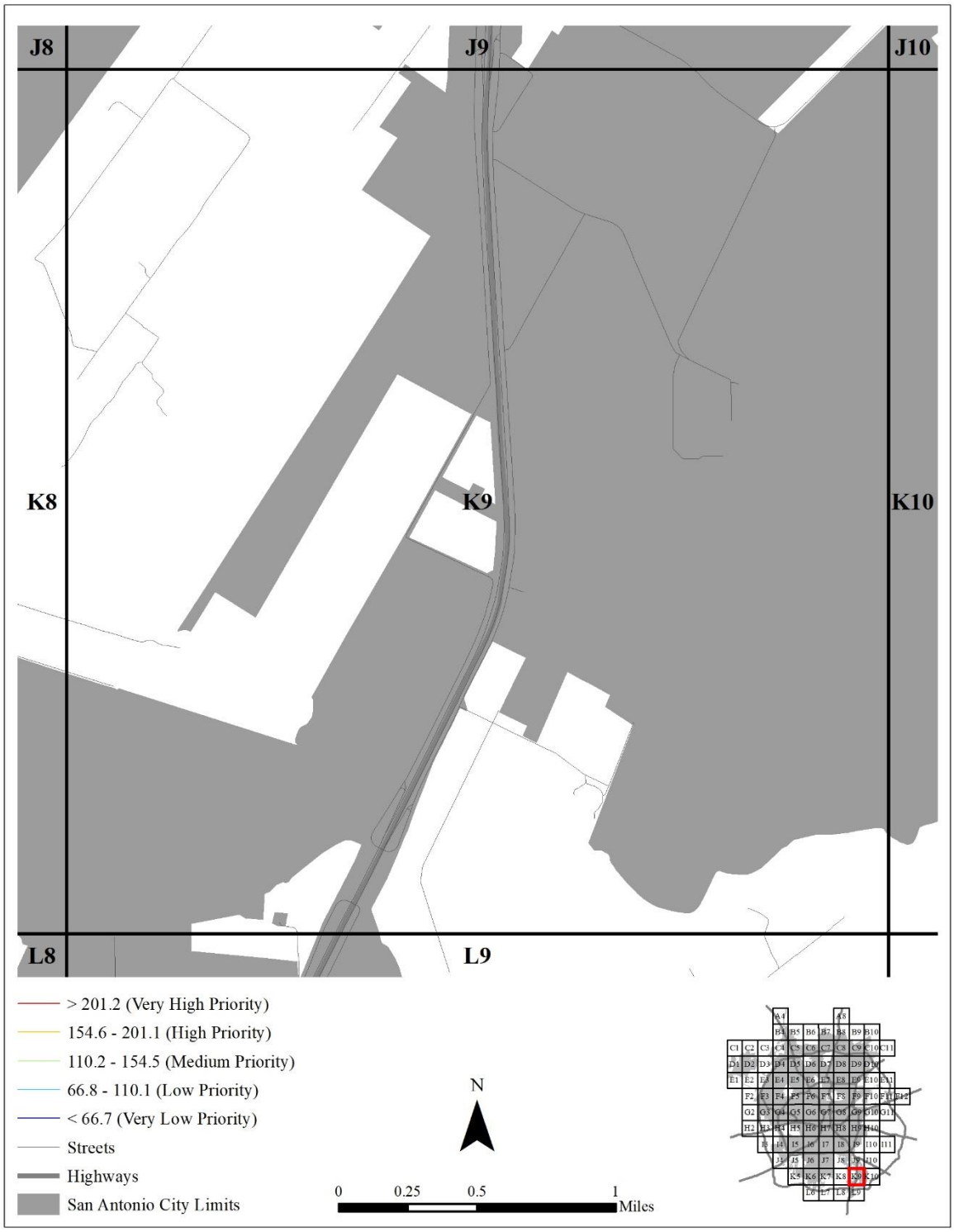

I9
I10
I11
J9
J10
K9
K10
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

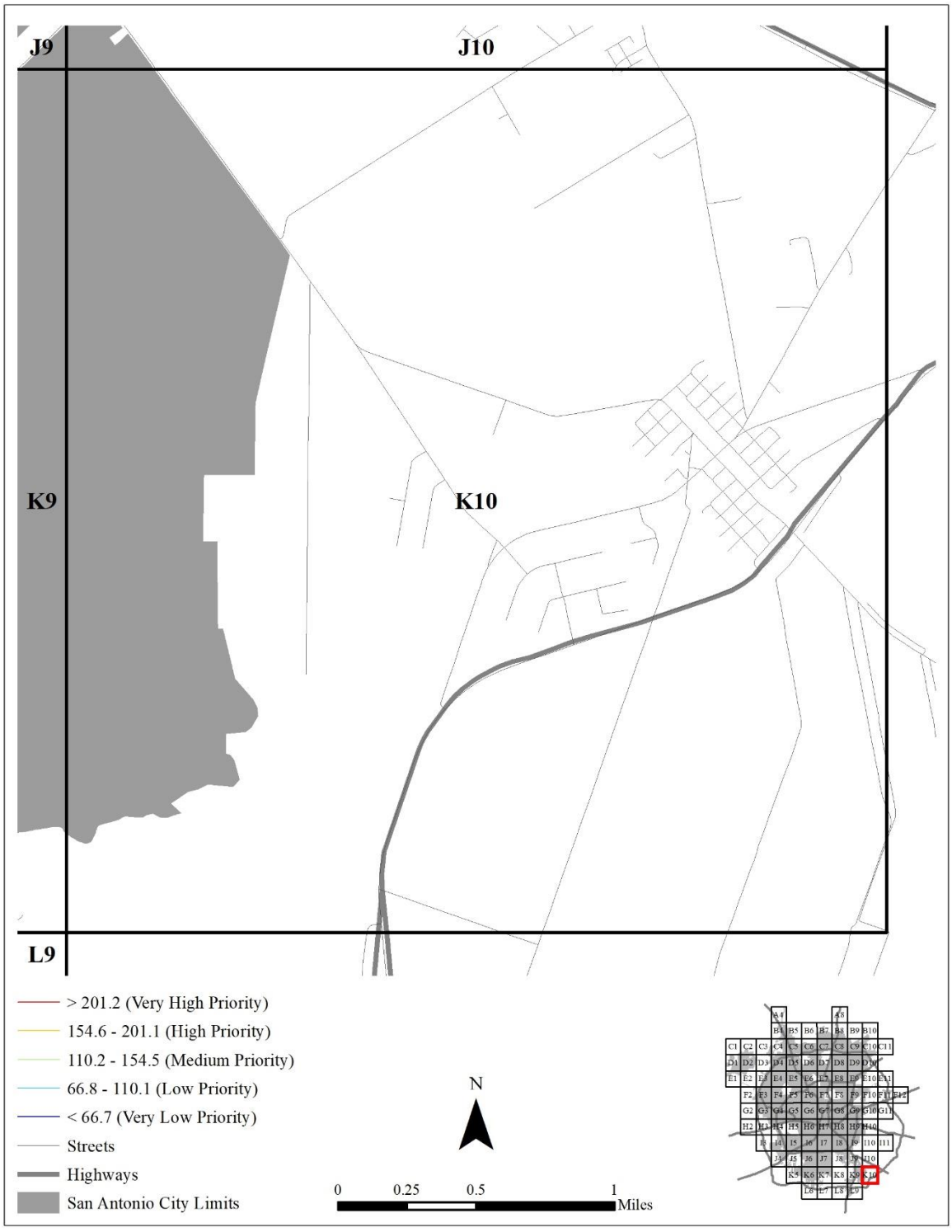

J4
J5
J6
K5
K6
L6
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles


J5
J6
J7
K5
K6
K7
L6
L7
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

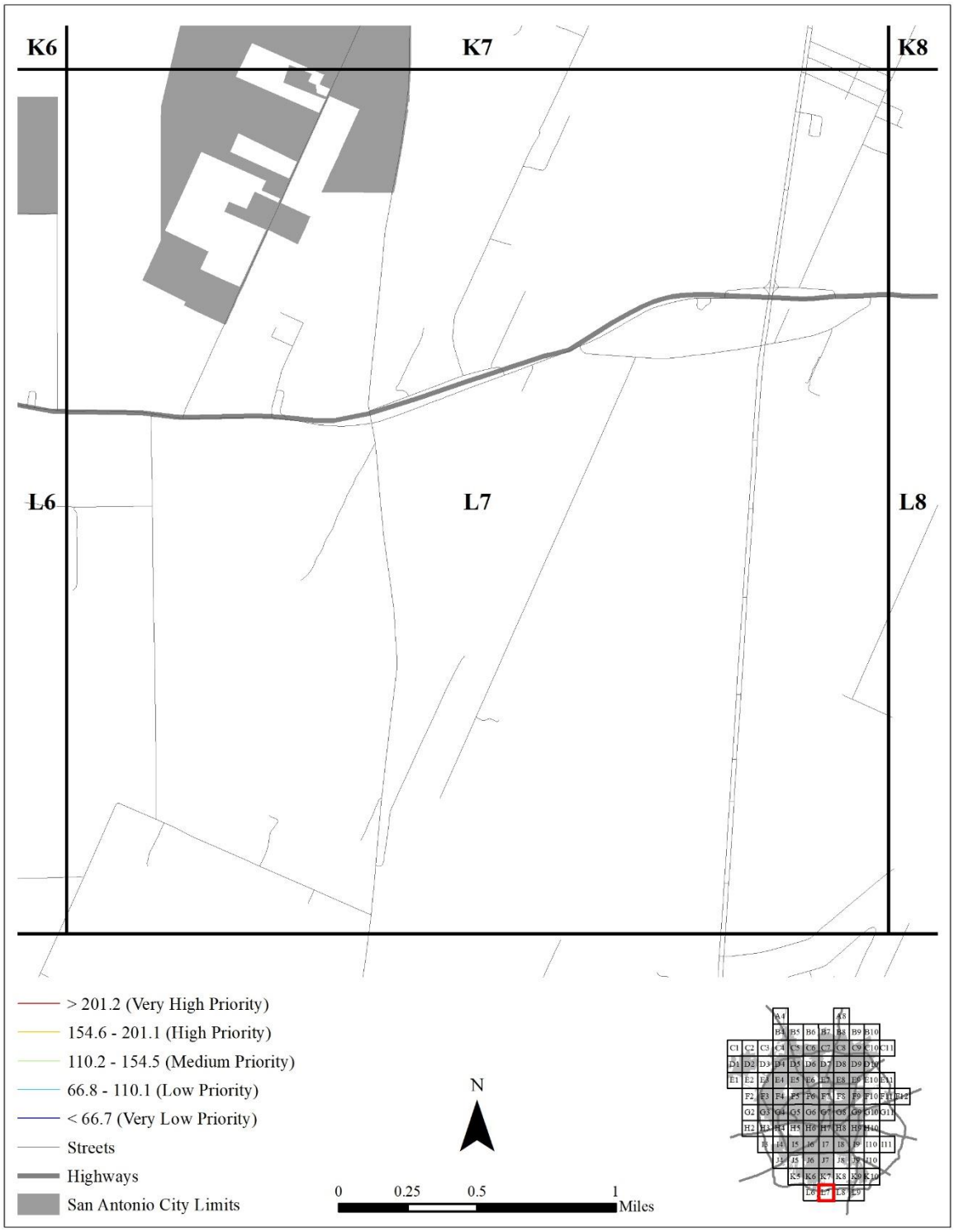

J6
J7
J8
K6
K7
K8
L6
L7
L8
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

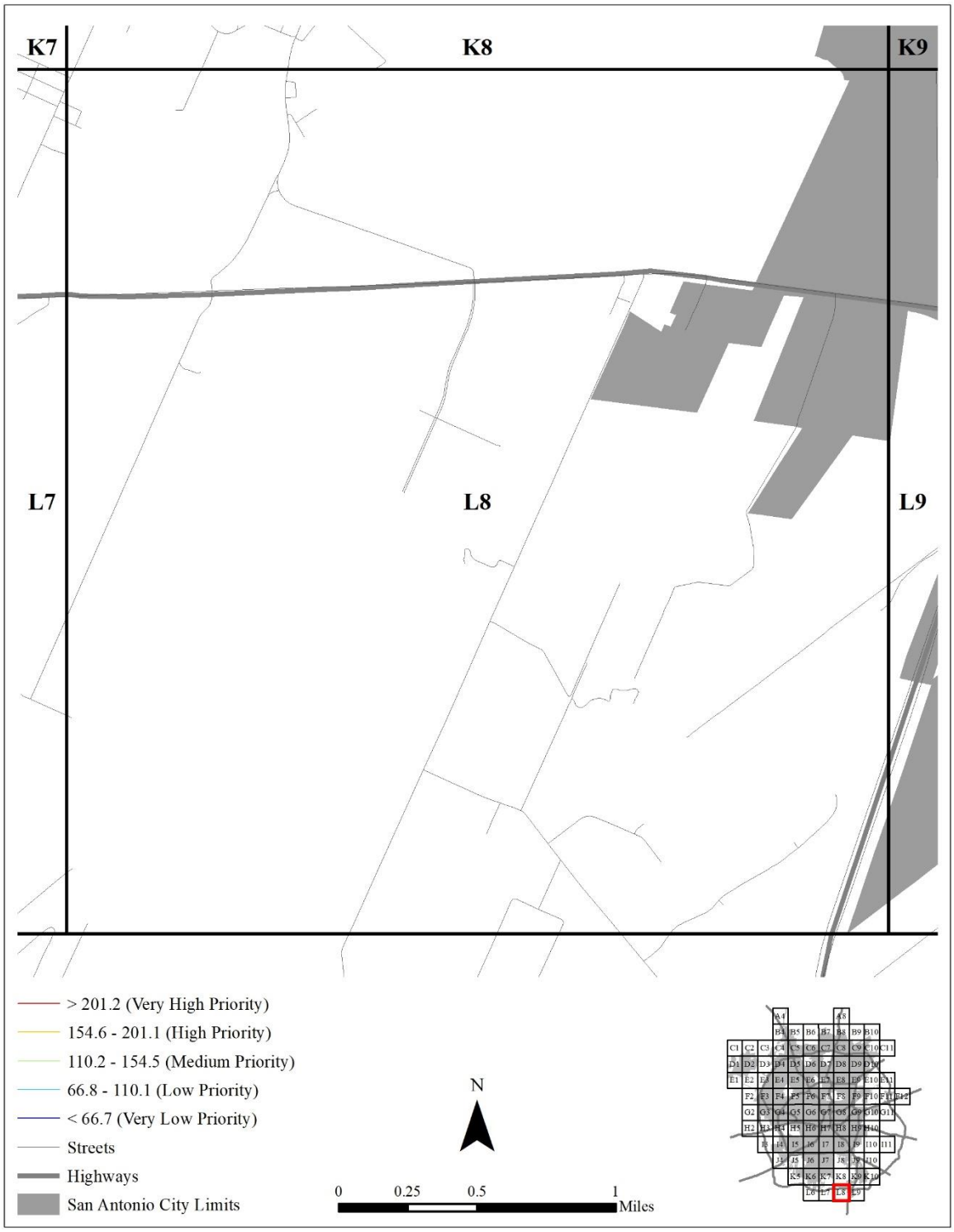

J7
J8
J9
K7
K8
K9
L7
L8
L9
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

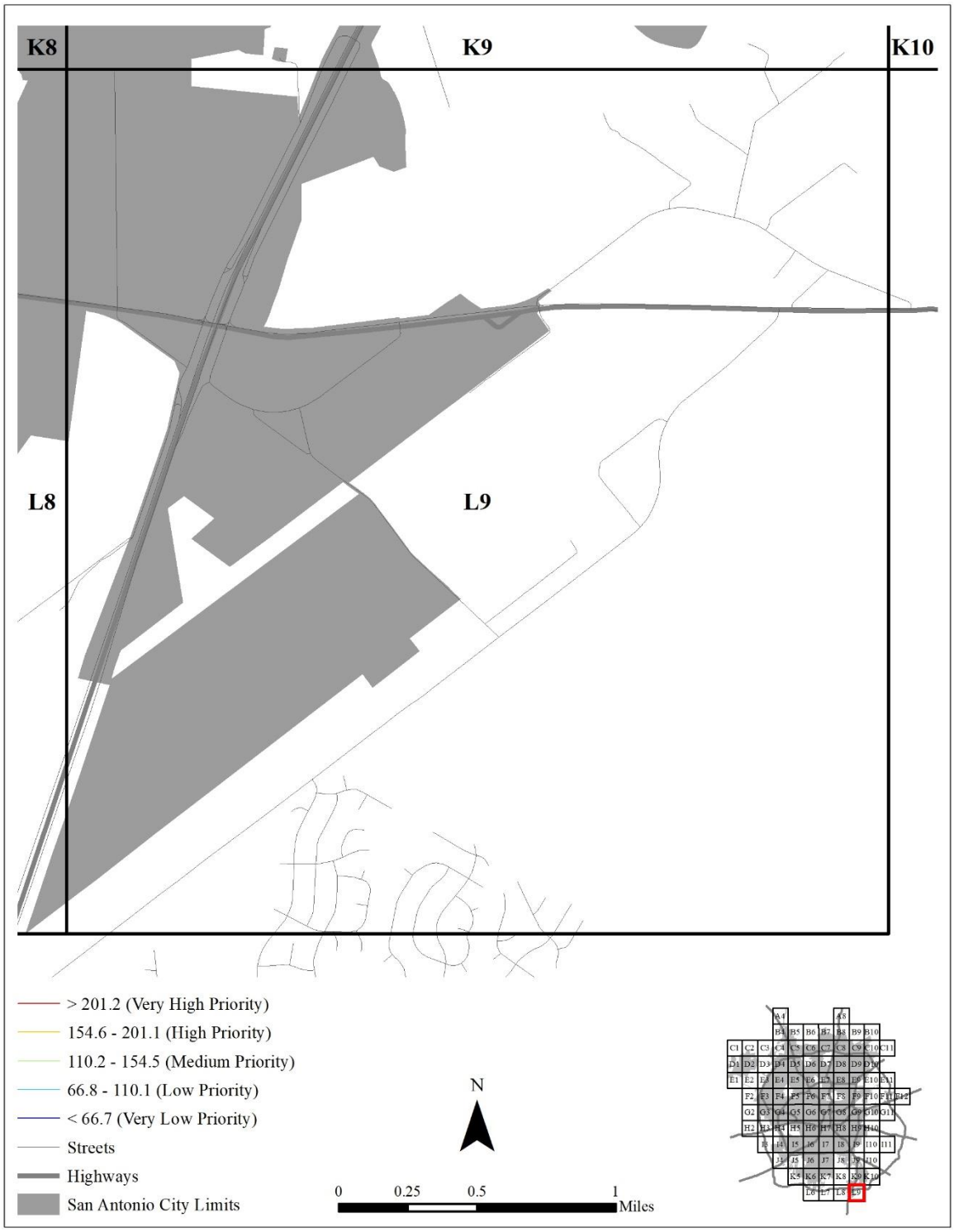

J8
J9
J10
K8
K9
K10
L8
L9
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles


J9
J10
K9
K10
L9
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

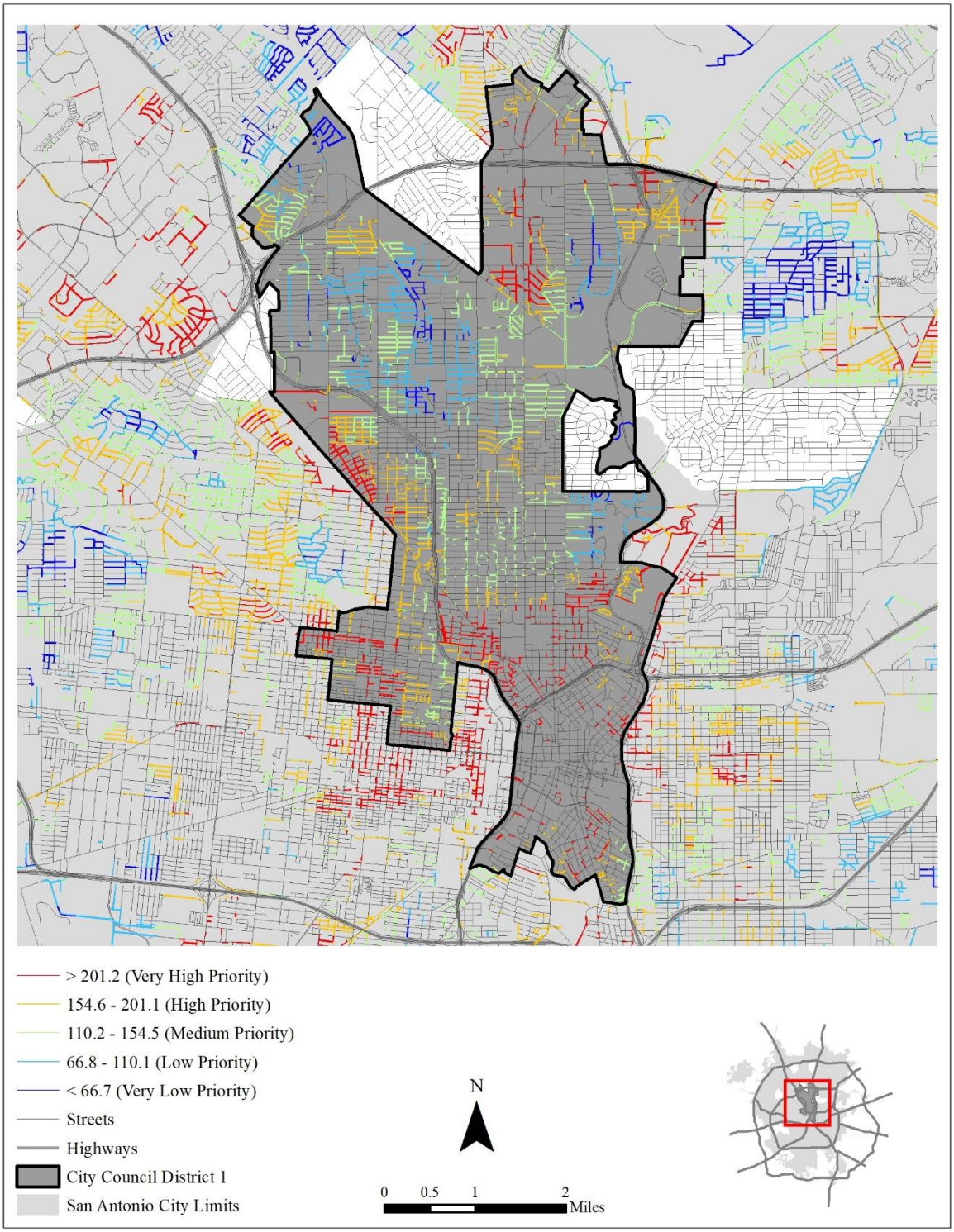

K5
K6
K7
L6
L7
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

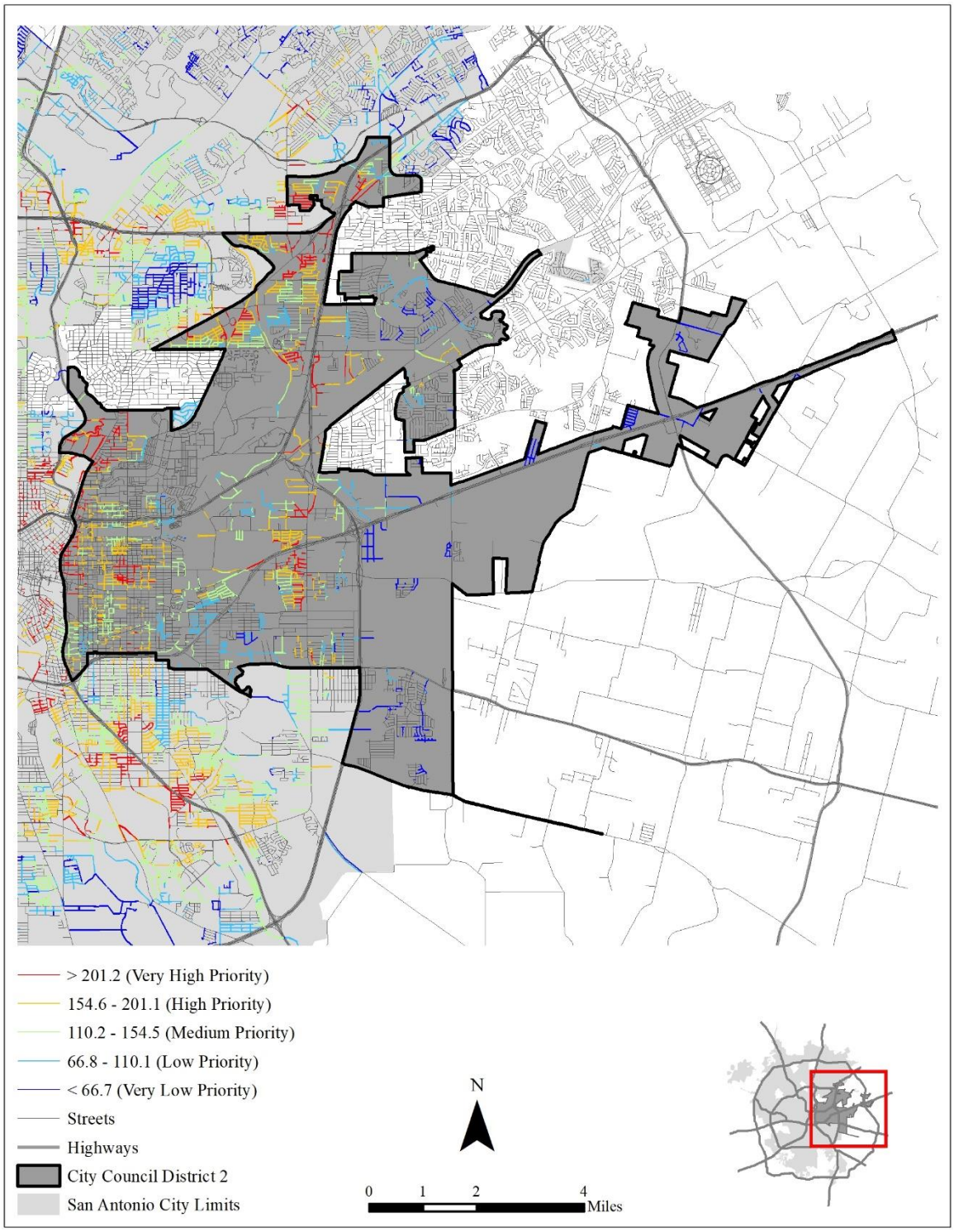

K6
K7
K8
L6
L7
L8
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

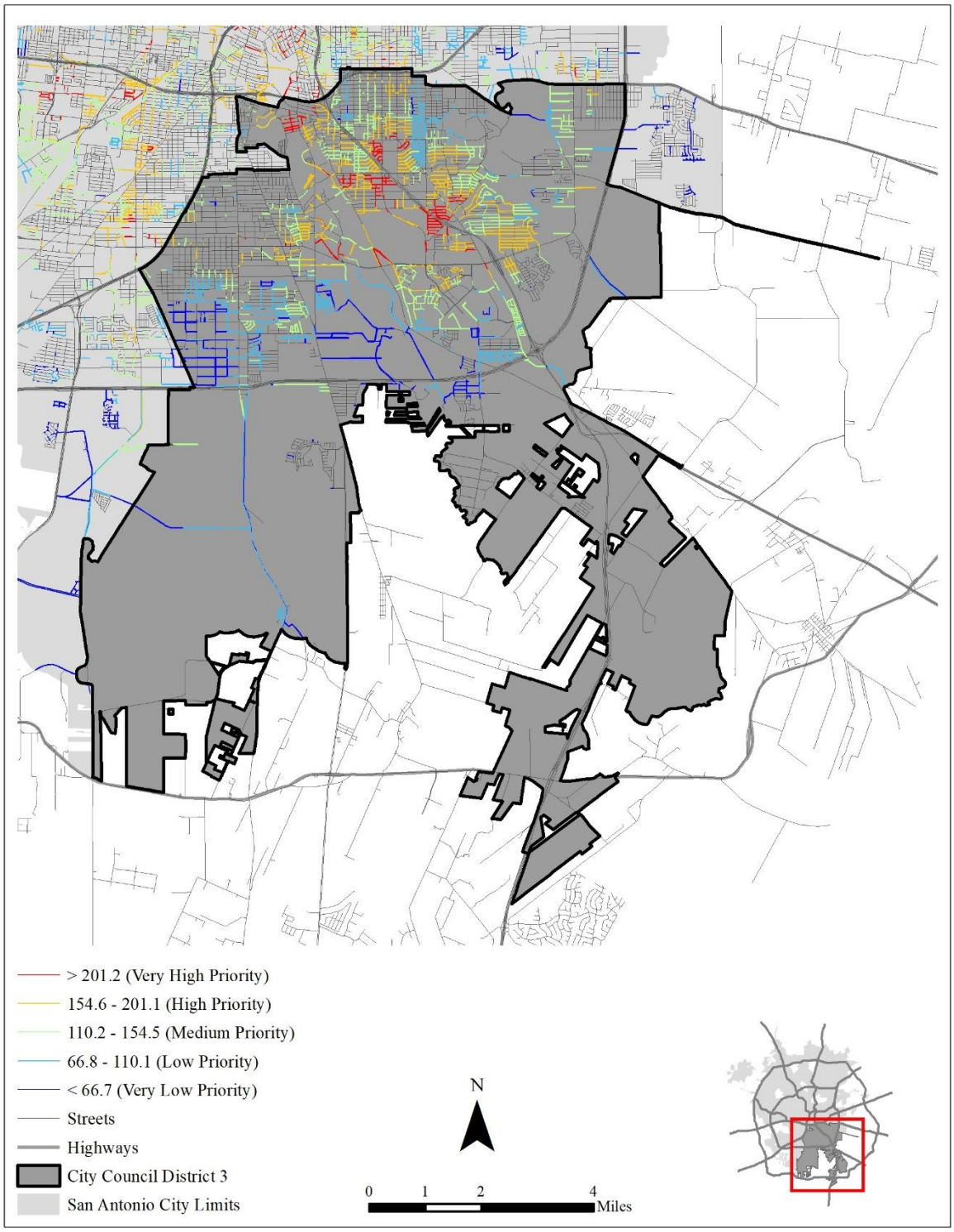

K7
K8
K9
L7
L8
L9
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

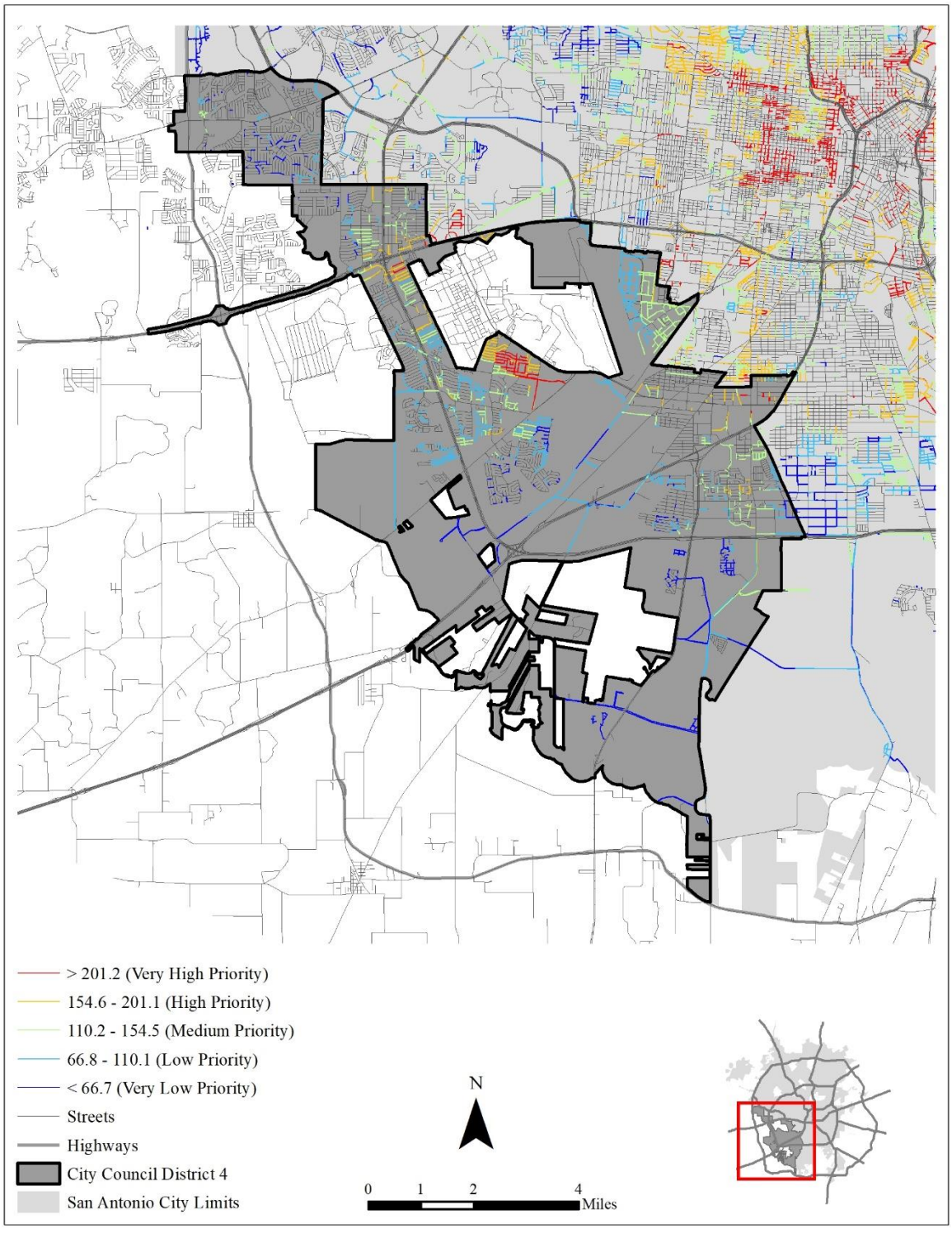

K8
K9
K10
L8
L9
> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
San Antonio City Limits
N
0
0.25
0.5
1
Miles

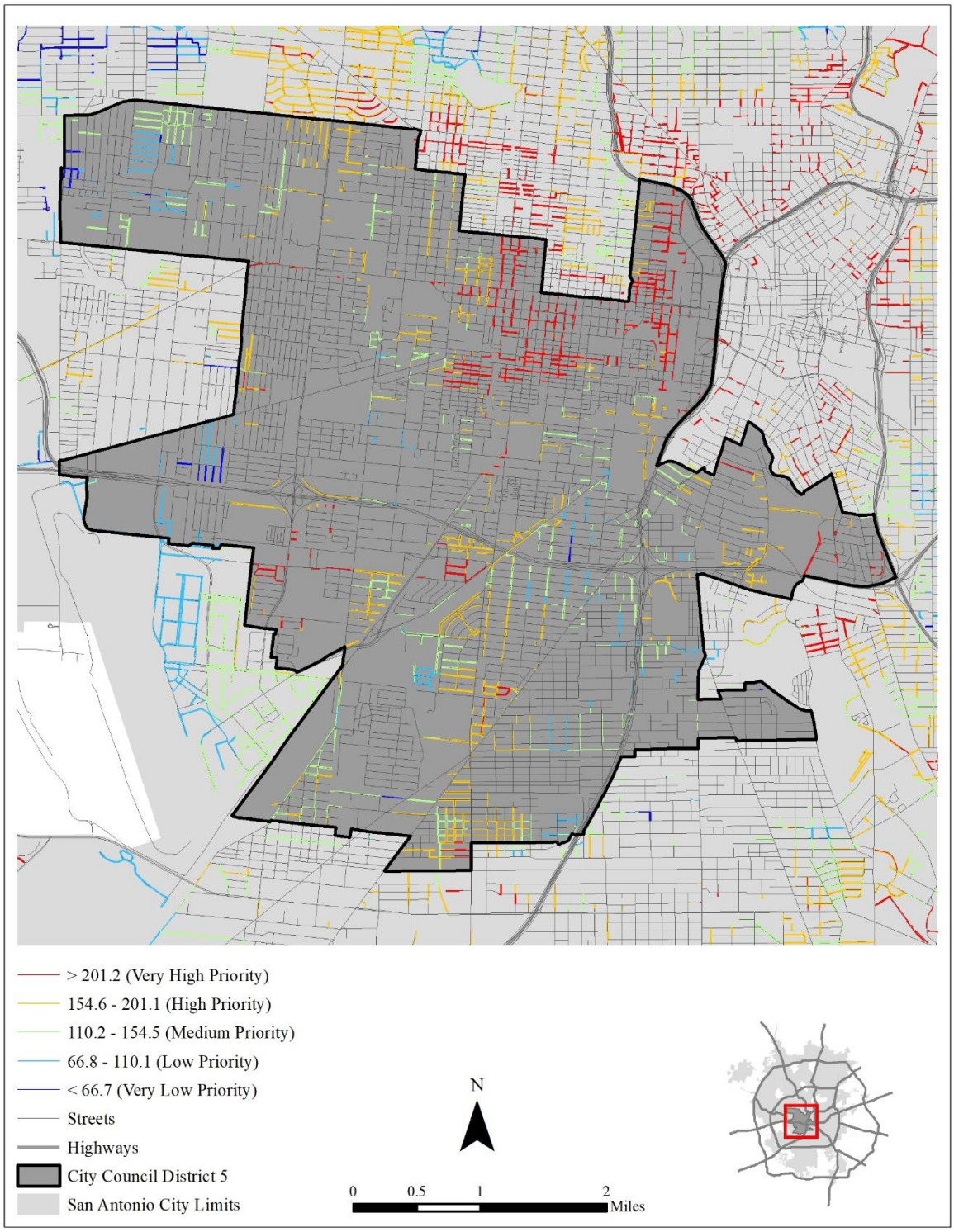
# Appendix E: Absent Sidewalks by Council District

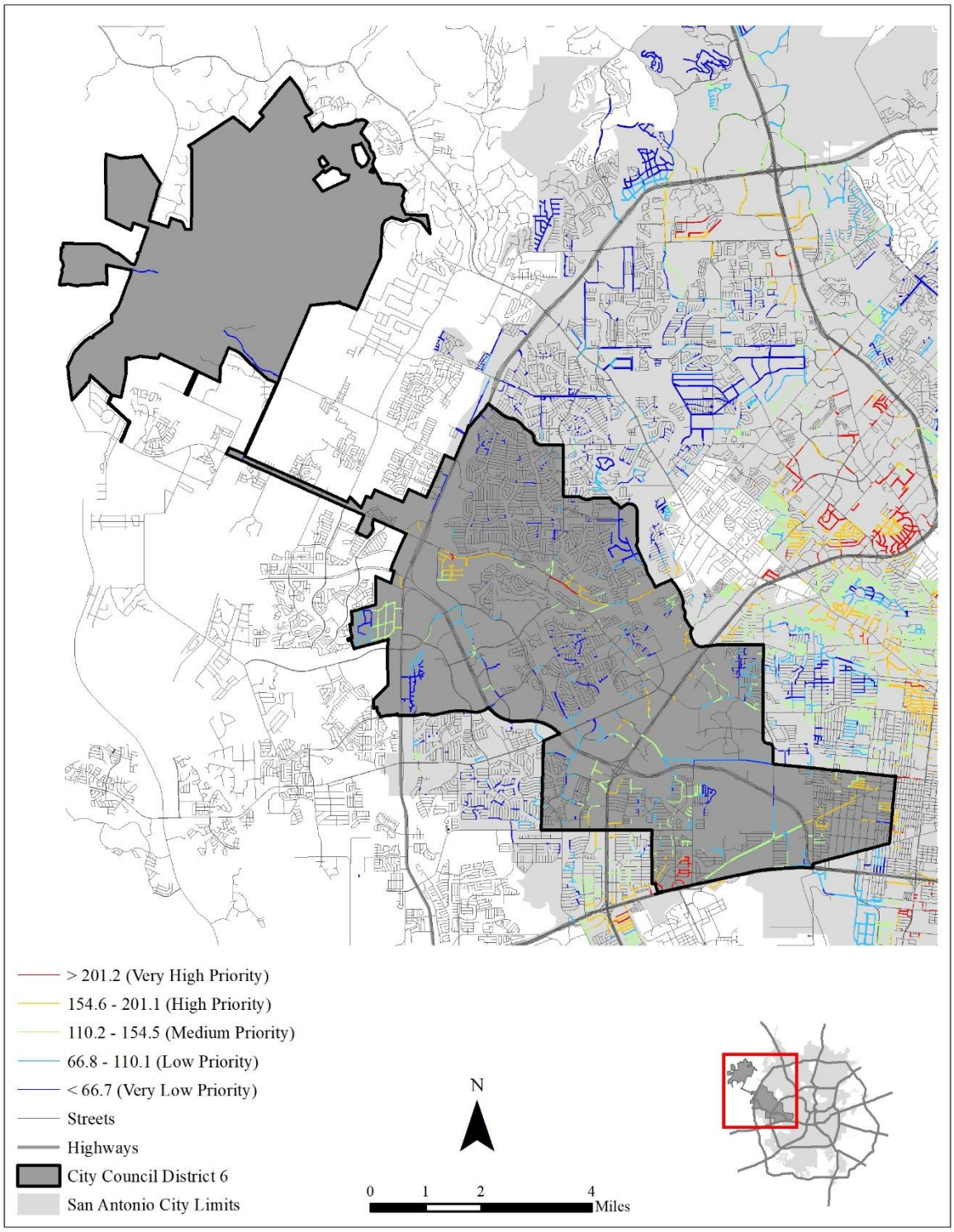


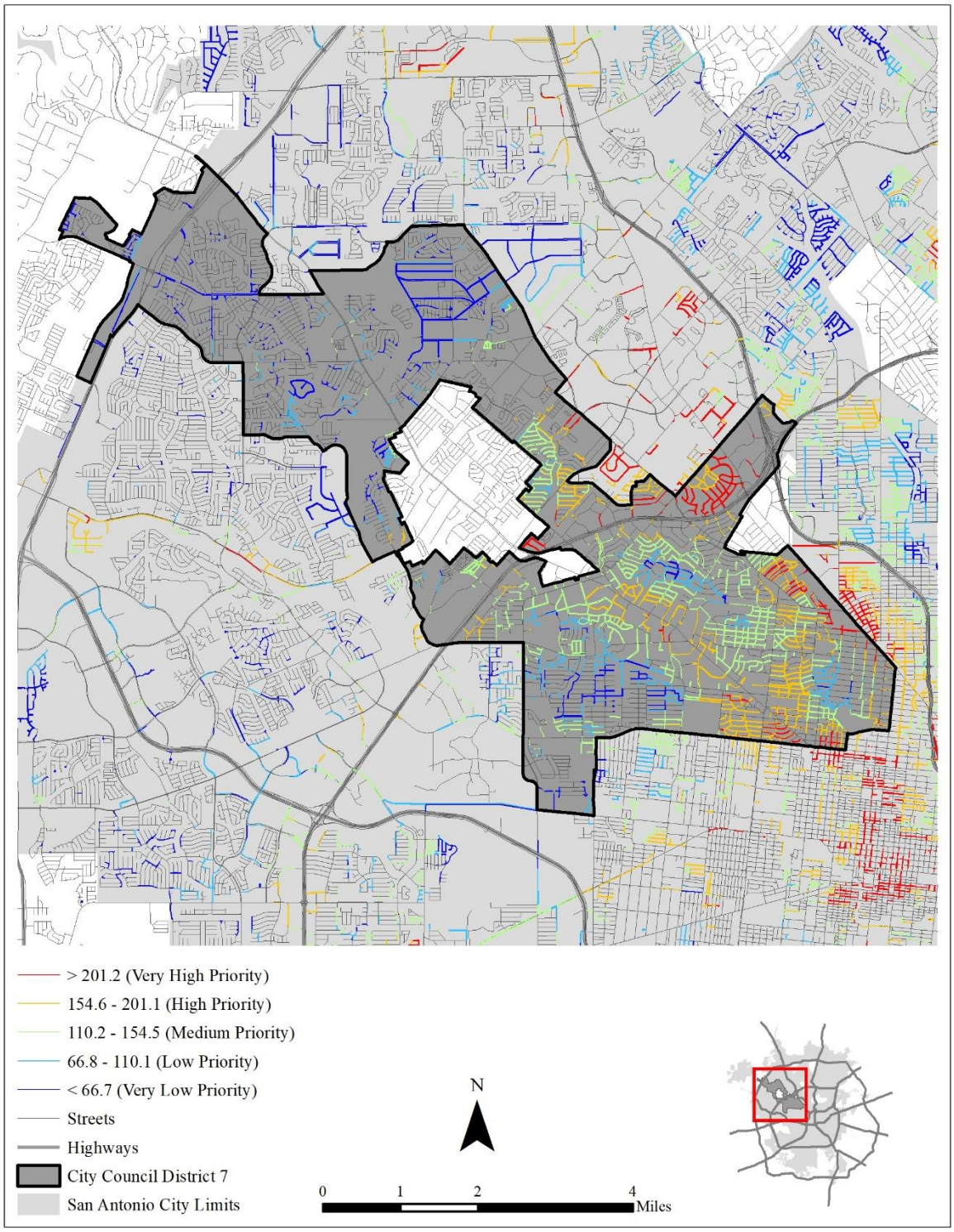

> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
City Council District 2
San Antonio City Limits
N
0
1
2
4
Miles

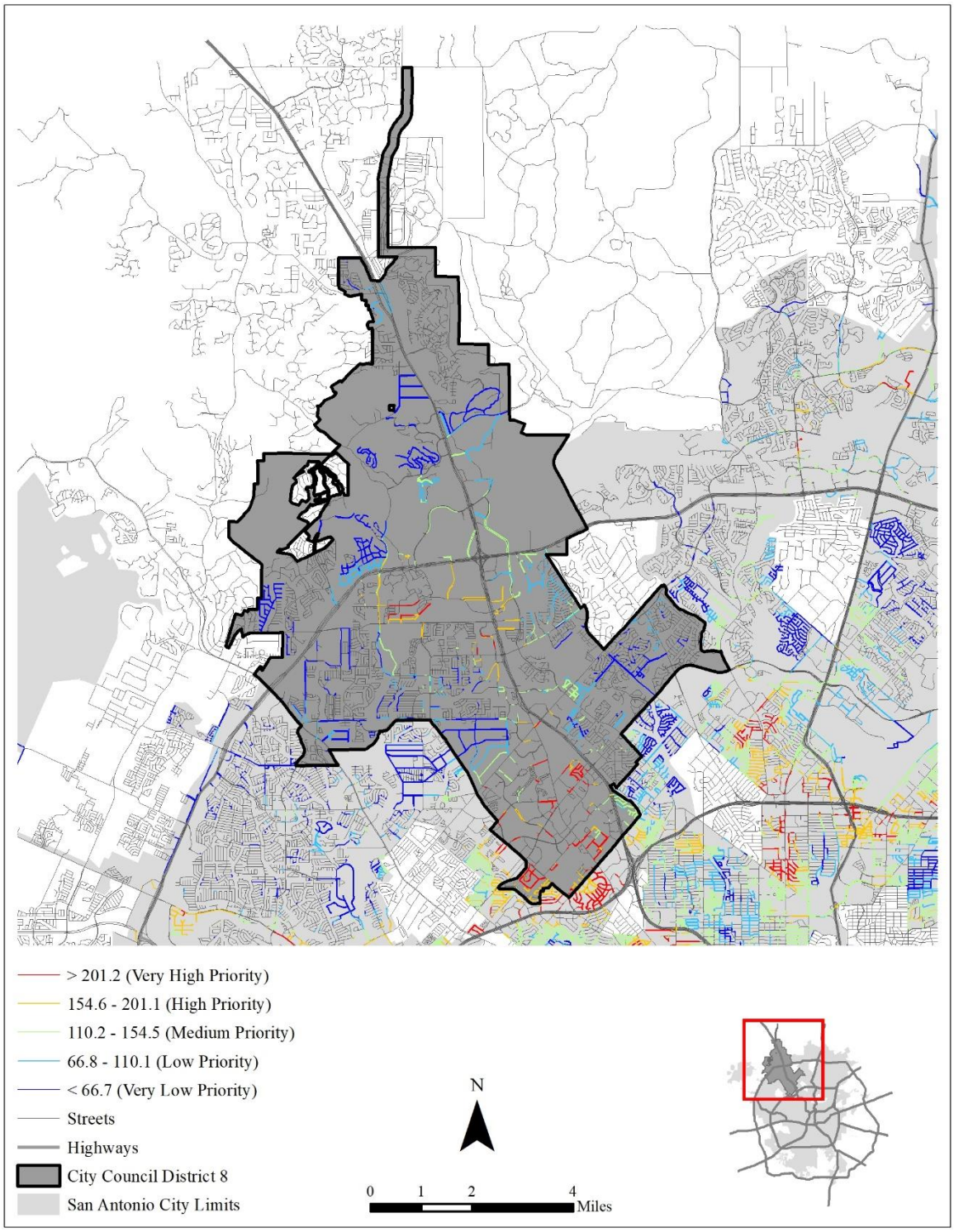

> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
City Council District 3
San Antonio City Limits
N
0
1
2
4
Miles

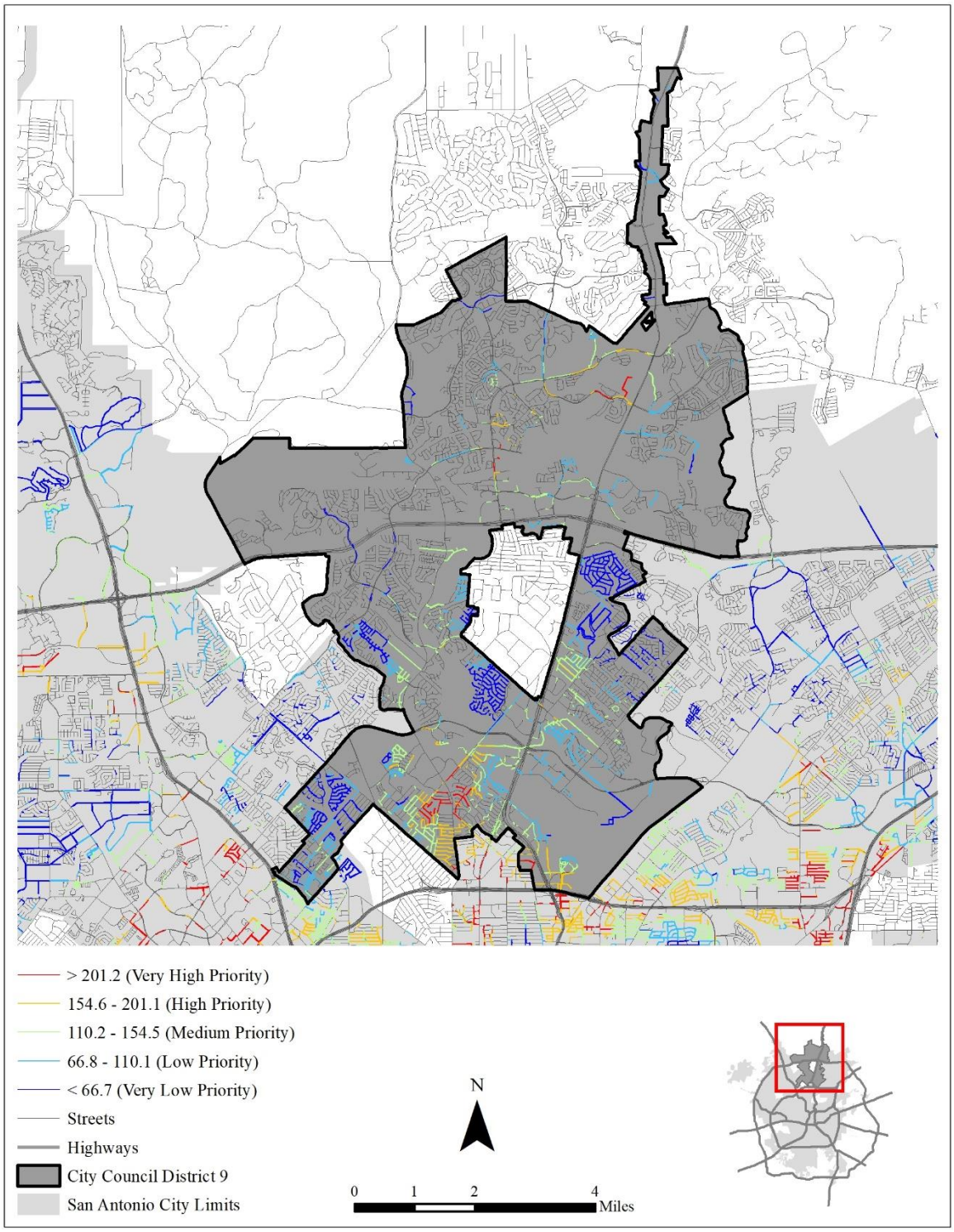

> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
City Council District 4
San Antonio City Limits
N
0 1 2 4
Miles

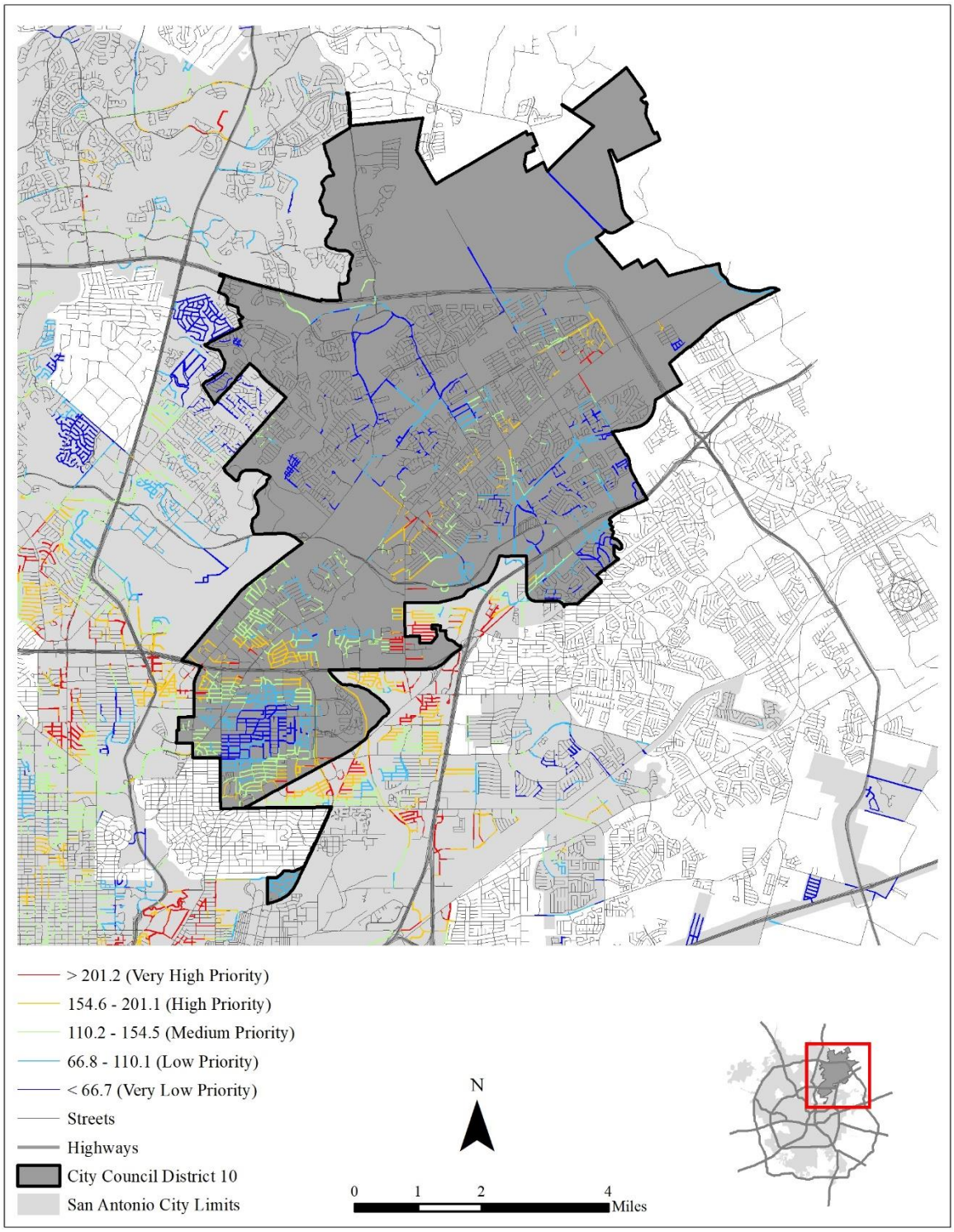

> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
City Council District 5
San Antonio City Limits
N
0
0.5
1
2
Miles


> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
City Council District 6
San Antonio City Limits
N
0
1
2
4
Miles


> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
City Council District 7
San Antonio City Limits
N
0
1
2
4
Miles


> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
City Council District 8
San Antonio City Limits
N
0 1 2 4
Miles


> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
City Council District 9
San Antonio City Limits
N
0
1
2
4
Miles


> 201.2 (Very High Priority)
154.6 - 201.1 (High Priority)
110.2 - 154.5 (Medium Priority)
66.8 - 110.1 (Low Priority)
< 66.7 (Very Low Priority)
Streets
Highways
City Council District 10
San Antonio City Limits
N
0
1
2
4
Miles

# DATA SOURCES

City of San Antonio. Council Districts. [Shapefile]. Retrieved from http://opendata-cosagis.opendata.arcgis.com/datasets?t=Political%20Boundary.

City of San Antonio. (2017). Facilities. [Shapefile].

City of San Antonio. Libraries. [Shapefile]. Retrieved from http://opendata-cosagis.opendata.arcgis.com/datasets?t=Development.

City of San Antonio. Park Boundaries. [Shapefile]. Retrieved from http://opendata-cosagis.opendata.arcgis.com/datasets?t=Park%20Recreation%20%26%20Historic%20Preservation.

City of San Antonio. Park Trails. [Shapefile]. Retrieved from http://opendata-cosagis.opendata.arcgis.com/datasets?t=Park%20Recreation%20%26%20Historic%20Preservation.

City of San Antonio. Park Trailheads. [Shapefile]. Retrieved from http://opendata-cosagis.opendata.arcgis.com/datasets?t=Park%20Recreation%20%26%20Historic%20Preservation.

City of San Antonio. (2017). Public Assembly. [Shapefile].

City of San Antonio. (2017). Public Schools. [Shapefile].

City of San Antonio. (2017). SA Tomorrow Corridors. [Shapefile].

City of San Antonio. (2017). SA Tomorrow Regional Centers. [Shapefile].

City of San Antonio. Sidewalks. [Shapefile]. Retrieved from http://opendata-cosagis.opendata.arcgis.com/datasets?t=Transportation.

City of San Antonio. (2017). Streets. [Shapefile].

Esri. (2016). *ArcGIS Business Analyst*. Texas employers.

Esri. (2016). *Esri Demographics.*

Texas Department of Transportation. *Crash Records Information System (C.R.I.S.)*. Retrieved from https://cris.dot.state.tx.us/public/Query/app/public/welcome.

U.S. Census Bureau. Bexar County, Texas Census Tracts: 2015 ACS 5-Year Estimates (Tracts). [Shapefile]. Retrieved from http://factfinder2.census.gov.

U.S. Census Bureau. Bexar County, Texas, Table B19001 Household Income in the Past 12 Months (In 2015 Inflation-Adjusted Dollars): 2015 ACS 5-Year Estimates (Tracts). [Shapefile]. Retrieved from http://factfinder2.census.gov.

U.S. Census Bureau. Bexar County, Texas, Table DP02 Selected Social Characteristics in the United States: 2015 ACS 5-Year Estimates (Tracts). [Shapefile]. Retrieved from http://factfinder2.census.gov.

U.S. Census Bureau. Bexar County, Texas, Table S0101 Age and Sex: 2015 ACS 5-Year Estimates (Tracts). [Shapefile]. Retrieved from http://factfinder2.census.gov.

U.S. Census Bureau. Bexar County, Texas, Table S0801 Commuting Characteristics by Sex: 2015 ACS 5-Year Estimates (Tracts). [Shapefile]. Retrieved from http://factfinder2.census.gov.

U.S. Census Bureau. Bexar County, Texas, Table S0801 Commuting Characteristics by Sex: 2015 ACS 5-Year Estimates (Tracts). [Shapefile]. Retrieved from http://factfinder2.census.gov.

U.S. Census Bureau. TIGER/Line: 2015. [Shapefile]. Retrieved from http://factfinder2.census.gov.

VIA. (2017). High Capacity Transit Route. [Shapefile].

VIA. (2017). Local Transit Route. [Shapefile].

# REFERENCES


Alta Planning + Design, prepared for City of Memphis. (2015). Al. *Memphis Pedestrian and School Safety Action Plan.*

Alta Planning + Design, prepared for City of Salt Lake City. (2015). *Salt Lake City Pedestrian & Bicycle Master Plan.*

Appleyard, B. S. (2003). Planning Safe Routes to School. *Planning, 69*(5), 34-37.

Behzadian, Majid, Kazemzadeh, R.B., Albadvi, A., & Aghdasi, M. (2010). PROMETHEE: A Comprehensive Literature Review on Methodologies and Applications. *European journal of Operational research, 200*(1), 198-215.

Beinat, E., and Nijkamp, P., eds. (1998). *Multicriteria Analysis for Land-Use Management*, *9*. Springer Science & Business Media.

Boarnet, Marlon G., Anderson, C. L., Day, K., McMillan, T. & Alfonzo, M. (2005). Evaluation of the California Safe Routes to School Legislation: Urban Form Changes and Children's Active Transportation to School. *American journal of preventive medicine, 28*(2), 134-140.

Brans, J.P., Vincke, Ph., & Mareschal, B. (1986). How to select and how to rank projects: The PROMETHEE method. European Journal of Operational Research *24*(2), 228–238.

Cervero, Robert, & Kara Kockelman. (1997). Travel Demand and the 3Ds: Density, Diversity, and Design. *Transportation Research Part D: Transport and Environment 2*(3), 199-219.

City of Alexandria. (2016). *City of Alexandria Transportation Master Plan: Pedestrian and Bicycle Chapter*.

City of Austin, MWM Design Group, and HDR. (2016). *City of Austin Sidewalk Master Plan / ADA Transition Plan Update.*

City of Charlotte. (2017). *Charlotte WALKS Pedestrian Plan*.

City of Fort Collins. (2011). *Pedestrian Plan Fort Collins*.

City of Nashville. (2017). *WalkNBike.*

City of Nashville. (2016). *WalkNBike Peer City and Aspirational City Review*.

City of Raleigh. (2012). *Raleigh Pedestrian Plan*.

City of San Antonio Office of the City Auditor. *Sidewalk Project Costs Summary*. Retrieved from http://3snpdc2ba9m5uwuk62n8cs84-wpengine.netdna-ssl.com/wp-content/uploads/2018/02/Sidewalk-Project-Costs-Summary.pdf.

City of San Antonio. *Infrastructure Management Program*. Retrieved from http://www.sanantonio.gov/TCI/Projects/Infrastructure-Management-Program.

City of San Antonio. *Proposed 2017-2022 Proposed Bond Program Information Guide*. Retrieved from http://www.sanantonio.gov/2017Bond.

City of San Antonio. *Sidewalk Cost Sharing Program*. Retrieved from http://www.sanantonio.gov/Portals/0/Files/TCI/sidewalk-cost-sharing-program-brochure.pdf.

City of San Antonio. *Vision Zero Initiative*. Retrieved from http://www.sanantonio.gov/TCI/Vision-Zero.

Clark, A. (2016, June 13). Suing for Sidewalks. *Next City*. Retrieved from https://nextcity.org/features/view/ada-compliance-accessible-design-cities-lawsuits-doj.

Cohen, L. (2015, October 8). Federal Lawsuit Claims Seattle Sidewalks, Streets Are Inadequate. *KOMO News*. Retrieved from http://komonews.com/news/local/federal-lawsuit-claims-seattle-sidewalks-streets-are-inadequate.

Conger, J. (2018, February 20). A Gap in San Antonio's Sidewalks. *News4SA*. Retrieved from http://news4sanantonio.com/news/local/a-gap-in-san-antonios-sidewalks.

De Montis, Andrea, De Toro, P., Droste-Franke, B., Omann, I., & Stagl, S. (2004). Assessing the quality of different MCDA methods. *Alternatives for environmental valuation*. 99-133.

Dimmick, I. (2018, February 19). Treviño Demands 'Concrete Solutions' for San Antonio's $760M Sidewalk Gap. *The Rivard Report*. Retrieved from https://therivardreport.com/trevino-demands-concrete-solutions-for-san-antonios-760m-sidewalk-gap/.

Dodgson, J. S., Spackman, M., & Phillips, L.D. (2009). Multi-Criteria Analysis: A Manual.

Domonoske, C. (2018, February 28). Pedestrian Fatalities Remain at 25-Year High for Second Year in a Row. *The Two-Way*. Retrieved from https://www.npr.org/sections/thetwo-way/2018/02/28/589453431/pedestrian-fatalities-remain-at-25-year-high-for-second-year-in-a-row.

Esri. *Esri Demographics,* http://doc.arcgis.com/en/esri-demographics/data/business.htm.

Ewing, R., & Cervero, R. (2010). Travel and the Built Environment: A Meta-Analysis. *Journal of the American Planning Association 76*(3), 265-294.

Ewing, R., Schroeer, W., & Greene, W. (2004). School Location and Student Travel Analysis of Factors Affecting Mode Choice. *Transportation Research Record: Journal of the Transportation Research Board, 1895*, 55-63.

Fehr & Peers, prepared for City and County of Denver. (2017). *Denver Moves Pedestrians & Trails – Draft*.

Goodyear, S. (2015, April 7). Why L.A.'s $1.4 Billion Sidewalk Repair Case Is Such a Big Deal. Citylab. Retrieved from https://www.citylab.com/transportation/2015/04/why-las-14-billion-sidewalk-repair-case-is-such-a-big-deal/389793/.

Guerra, E., Cervero, R., & Tischler, D. (2012). Half-Mile Circle: Does it Best Represent Transit Station Catchments? *Transportation Research Record: Journal of the Transportation Research Board 2276*, 101-109.

Johansson-Stenman, O. (1998). The importance of Ethics in Environmental Economics with a Focus on Existence Values. *Environmental and Resource Economics 11*(3-4), 429-442.

Kabir, G, Sadiq, R., & Tesfamariam, S. (2014). A Review of Multi-Criteria Decision-Making Methods for Infrastructure Management. *Structure and Infrastructure Engineering 10*(9), 1176-1210.

Liu, Muqing, Balali, V., Wei, H., & Peña-Mora, F.A. (2015). Scenario-Based Multi-Criteria Prioritization Framework for Urban Transportation Projects. *American Journal of Civil Engineering and Architecture 3*(6), 193-199.

Louisville Metro Public Works and Assets. (2010). *Pedestrian Master Plan*.

Marcelo, D., Mandri-Perrott, C., House, S., & Schwatrz, J. (2016). Prioritizing Infrastructure Investment: A Framework for Government Decision Making.

Marks, M. (2015, September 22). Why are San Antonio's Sidewalks Such a Mess? *San Antonio Current*. Retrieved from https://www.sacurrent.com/sanantonio/why-are-san-antonios-sidewalks-such-a-mess/Content?oid=2472439.

Martin, S., & Carlson, S. (2005). Barriers to Children Walking to or From School-United States, 2004 (Reprinted from MMWR, *54*, 949-952, 2005). Jama-Journal of the American Medical Association *294*(17), 2160-2162.

McKenzie, B. (2014). *Modes Less Traveled: Bicycling and Walking to Work in the United States, 2008-2012*. No. ACS-25. US Department of Commerce, Economics and Statistics Administration, US Census Bureau.

Merck, A. (2017, January 10). San Antonio is More Dangerous for Pedestrians. *The Rivard Report*. Retrieved from https://therivardreport.com/san-antonio-is-more-dangerous-for-pedestrians/.

MIG & City of San Antonio. (2016). *SA Tomorrow Comprehensive Plan*.

MWM Design Group and City of Austin. (2015). *City of Austin Sidewalks Peer Cities Report.*

Nevelsteen, K., Steenberghen, T., Van Rompaey, A., & Uyttersprot, L. (2012). Controlling Factors of the Parental Safety Perception on Children's Travel Mode Choice. *Accident Analysis & Prevention 45*, 39-49.

Nijkamp, Peter, & Delft, A. (1977). *Multi-Criteria Analysis and Regional Decision-Making*. *8,* Springer Science & Business Media.

Ogden, C. L., Carroll, M. D., Kit, B. K., & Flegal, K. M. (2014). Prevalence of Childhood and Adult Obesity in the United States, 2011-2012. Jama-Journal of the American Medical Association *311*(8), 806-814.

O'Hare, P. (2017, April 4). San Antonio's City Council District 5 Candidates Take on Crumbling Streets and Sidewalks. *My San Antonio*. Retrieved from https://www.mysanantonio.com/news/local/article/San-Antonio-s-City-Council-District-5-11049275.php.

Rivara, F. P., Bergman, A. B., & Drake, C. (1989). Parental Attitudes and Practices Toward Children as Pedestrians. *Pediatrics 84*(6), 1017-1021.

Saelens, B. E., & Handy, S. L. (2008). Built Environment Correlates of Walking: A Review. *Medicine and Science in Sports and Exercise 40*(7), Suppl S550.

Saitua, R. (2007). Some Considerations on Social Cost–Benefit Analysis as a Tool for Decision-Making. *Chapters*.

Schmidt, A., Ivanova, A., & Schäfer, M. S. (2013). Media Attention for Climate Change Around the World: A Comparative Analysis of Newspaper Coverage in 27 Countries. Global Environmental Change *23*(5), 1233-1248.

Schmitt, A. (2018, February 1). A Quick-And-Dirty Fix for Sidewalkless Streets. *Streetsblog USA*. Retrieved from https://usa.streetsblog.org/2018/02/01/a-quick-and-dirty-fix-for-sidewalkless-streets/.

Schneider, R. J. (2013). Theory of Routine Mode Choice Decisions: An Operational Framework to Increase Sustainable Transportation. Transport Policy *25*, 128-137.

Seattle Department of Transportation. (2017). *Seattle Pedestrian Master Plan: 2018-2022 Implementation Plan and Progress Report.*

Selcraig, B. (2018, January 13). S.A. Ignores its Rule that Homeowners Pay for Sidewalks. *San Antonio Express-News*, 13. Retrieved from https://www.expressnews.com/news/local/article/S-A-ignores-its-rule-that-homeowners-pay-for-12496289.php. Accessed 30 March 2018.

Selcraig, B. (2018, February 23). San Antonio Traffic Deaths Spiked in 2016 – But Dropped in 2017. *San Antonio Express-News,* 23. Retrieved from https://www.expressnews.com/news/local/article/San-Antonio-traffic-deaths-spiked-in-2016-but-12703608.php.

Serna, S. (2015, December 22). City Looks at New Way to Fix Sidewalks. *KSAT*, 22. Retrieved from https://www.ksat.com/news/city-looks-at-new-way-to-fix-sidewalks.

Serna, S. (2018, February 19). Councilman Trevino Wants More City Sidewalks. *KSAT*, 19. Retrieved from https://www.ksat.com/news/councilman-trevio-wants-more-city-sidewalks.

Shoup, D. (2009). Putting cities back on their feet. *Journal of Urban Planning and Development* 1*36*(3), 225-233.

Thomopoulos, N., Grant-Muller, S., & Tight, M. R. (2009). Incorporating Equity Considerations in Transport Infrastructure Evaluation: Current Practice and a Proposed Methodology. *Evaluation and program planning 32*(4), 351-359.

Tsamboulas, D. A. (2007). A Tool for Prioritizing Multinational Transport Infrastructure Investments. *Transport Policy 14*(1), 11-26.

Tscheikner-Gratl, F., Egger, P., Rauch, W., Kleidorfer, M. (2017). Comparison of Multi-Criteria Decision Support Methods for Integrated Rehabilitation Prioritization. *Water 9*(2), 68-95.

United States, Department of Justice Civil Rights Division. (2016). *The Americans with Disabilities Act of 1990.* Federal Register.

United States, Department of Health and Human Services. (2015). Step It Up! The Surgeon General's Call to Action to Promote Walking and Walkable Communities.

Villalobos, C. (2018, April 2). Existing Sidewalk Condition Assessment. Received by Robert Anderson.

White, R. & Villarreal, C. (2013). *Utility Investment Valuation Strategies: A Case for Adopting Real Options Valuation.* California Public Utilities Commission, Policy & Planning Division (PPD).

Ziviani, J., Scott, J., & Wadley, D. (2004). Walking to School: Incidental Physical Activity in the Daily Occupations of Australian Children. *Occupational Therapy International 11*(1), 1-11.

# Vita

Robert Anderson completed a Bachelor of Arts in Geography from the University of Iowa. It was during this time that he became interested in pedestrianism. His interest in walking and traffic safety was reinforced by years of living car-free.

Robert worked as a professional planner while completing his master's degree. He worked as a long-range planner at the City of Austin, TX where he developed policies and programs to provide for a more walkable city, including a Complete Streets Policy, a Vision Zero Program, and the Pedestrian Advisory Council. Robert also worked as a Senior Planner for the City of San Antonio, TX. Upon completion of his Master of Science in Community and Regional Planning with Specializations in Land Development and Transportation, expected May 2018, he will continue as a Graduate Transportation Planner with Big Red Dog Engineering and Consulting.

Contact: robertnanderson@gmail.com

This report was typed by Robert Anderson